



TETRA TECH EBA

# GEOTECHNICAL EVALUATION VILLAGE OF GLENWOOD ROADWAYS GLENWOOD, ALBERTA



PRESENTED TO  
**Village of Glenwood**

OCTOBER 2015  
ISSUED FOR USE  
FILE: L12103982-01



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## **LIMITATIONS OF REPORT**

This report and its contents are intended for the sole use of the Village of Glenwood and their agents. Tetra Tech EBA Inc. (Tetra Tech EBA) does not accept any responsibility for the accuracy of any of the data, the analysis, or the recommendations contained or referenced in the report when the report is used or relied upon by any Party other than the Village of Glenwood, or for any Project other than the proposed development at the subject site. Any such unauthorized use of this report is at the sole risk of the user. Use of this report is subject to the terms and conditions stated in Tetra Tech EBA's Services Agreement. Tetra Tech EBA's General Conditions are provided in Appendix A of this report.



## 1.0 INTRODUCTION

This report presents the results of a geotechnical evaluation conducted by Tetra Tech EBA Inc. (Tetra Tech EBA) for the proposed resurface of roadways within the Village of Glenwood, Alberta (Village).

The scope of work for this evaluation was outlined in an email proposal issued to Mr. Chad Parsons, of the Village, on August 4, 2015. The objective of this work was to determine the general subsurface conditions in the area of the proposed developments and to develop recommendations for the geotechnical aspects of design and construction for the project.

Authorization to proceed with the evaluation was provided by Mr. Parsons with a signed Services Agreement on August 11, 2015.

## 2.0 PROJECT DETAILS AND SCOPE OF WORK

It is understood that the Village is planning to resurface approximately 10 km of roadway with 75 mm cold mix asphalt overlay. Prior to installation of the new overlay, it should be determined if the existing gravel structure and subgrade soils are competent to support the proposed surface asphalt.

The scope of work for this evaluation comprised the completion of 41 geotechnical boreholes, a laboratory program to assist in classification of the subsurface soils, and a report providing the following foundation design and construction recommendations:

- Recommendations for granular course and subgranular course.
- Recommendations for subgrade preparation.
- Recommendations for backfill materials and compaction.
- Recommended construction provisions for control of groundwater.

## 3.0 GEOTECHNICAL FIELD AND LABORATORY WORK

The fieldwork for this evaluation was carried out on August 20 and 25, 2015 using a truck-mounted drill rig contracted from Chilako Drilling Services Ltd. of Coaldale, Alberta. The rig was equipped with 150 mm diameter solid stem continuous flight augers. Tetra Tech EBA's field representative was Mr. Stuart Smith.

The 41 boreholes (referenced as 15BH001 through 15BH019 and 15BH021 through 15BH042) were drilled on the roadway sections to depths ranging between 1.5 m and 3.0 m below ground surface. Borehole 15BH020 was not drilled due to site access constraints at the time of drilling. The approximate borehole locations are shown on Figure 1.

From the boreholes, disturbed grab samples were obtained at approximate 600 mm intervals. In addition, Standard Penetration Tests (SPTs) were generally performed at depth intervals of 0.75 m. All soil samples were visually classified in the field and the individual soil strata and the interfaces between them were noted. The borehole logs are presented in Appendix B. An explanation of the terms and symbols used on the borehole logs is also included in Appendix B.

Slotted 25 mm diameter PVC standpipes were installed in three boreholes (15BH011, 15BH026, and 15BH042) to monitor groundwater levels. Auger cuttings were backfilled around the standpipes and they were sealed at ground surface with bentonite chips and sand.

Classification tests, including natural moisture content determination and Atterberg Limits, were performed in a laboratory on samples collected from the boreholes to aid in the determination of engineering properties. The results of the laboratory tests are presented on the borehole logs.

## **4.0 SITE AND SUBSURFACE CONDITIONS**

### **4.1 Site Condition**

The Village roadways were observed to comprise bituminous surfacing in most areas, with some gravel surfacing on a few roads around the perimeter of the Village. The cold mix surfacing was observed to be showing signs of distress including rutting, potholes, as well as severe degradation at intersections. The roads generally have a mild crown to direct surface runoff toward ditches. Stormwater appears to be collected in ditches on either side of the roadways. No evidence of a subsurface stormwater collection system was noted.

In general, the observed pavement distress suggests that the bituminous surfacing is of poor quality, and in some areas the granular base material may not be providing adequate support. It is understood that prior to placement of the existing bituminous surfacing, the gravel surfacing had been treated with oil for many years. Based on the borehole logs, the clay subgrade is generally in good condition with only a few exceptions where softer clay subgrade conditions exist.

It was also noted that in some areas, the bituminous surfacing was soft enough that a person could indent with a thumb up to 5 mm deep.

### **4.2 Soil Stratigraphy**

It should be noted that geological conditions are innately variable. At the time of preparation of this report, information on subsurface stratigraphy was available only at discrete borehole locations. In order to develop recommendations from this information, it is necessary to make some assumptions concerning conditions other than at borehole locations. Adequate field reviews should be provided during construction to check that these assumptions are reasonable.

The general subsurface stratigraphy for the property was comprised of a surficial pavement structure (bituminous surfacing and/or granular layer) overlying a layer of clay fill, in return overlying native clay and clay till deposits.

The following sections provide a summary of the stratigraphic units encountered at the project site at the specific borehole locations. A more detailed description is provided on the borehole logs provided in Appendix B.

#### **4.2.1 Pavement Structure**

Bituminous surfacing was encountered at 25 borehole locations, with thicknesses varying between 30 mm and 160 mm. The measurement results of bituminous surfacing and granular base thicknesses are presented on Figure 1. Gravel fill (as granular base materials) was noted underlying the bituminous surfacing or as the surficial layer at more than one-third of the borehole locations, with thicknesses ranging between 90 mm and 780 mm (see Figure 1 for details). The gravel fill was described as sandy, silty, trace clay, well graded, sized to 25 mm (occasional 50 mm or 75 mm), subangular to subrounded, damp to moist, loose to compact, and brown.

At the borehole locations (nine boreholes in total indicated with "NA" for gravel thicknesses in Figure 1), the gravel fill has more than 40% clay by weight and was classified as clay fill with some gravel or gravelly.

## 4.2.2 Clay Fill

Clay fill was encountered below the pavement structure at the borehole locations, extending to depths ranging between 0.4 m and 2.0 m below ground surface. The clay fill was described as silty, some sand (occasional trace sand), trace gravel to gravelly, moist to very moist, medium plastic (occasional high plastic), firm to very stiff, and brown or grey. Moisture contents of clay fill samples ranged between 7% and 27%. Atterberg Limits testing (four tests) conducted on clay fill samples indicated Plastic Limits of 14%, 15%, 19%, and 20%; and Liquid Limits of 33%, 41%, 52%, and 62%; indicative of medium to high plasticity.

A hydrocarbon odour was noted within the clay fill. It is assumed that the odour is a result of years of oil being applied to the gravel surface, prior to placement of the bituminous surfacing.

## 4.2.3 Clay

Underlying the clay fill, native clay was encountered at only four borehole locations (15BH15, 15BH026, 15BH031, and 15BH038), extending to depths ranging between 1.2 m and 1.7 m below ground surface. The clay was generally described as silty, trace to some sand, moist, medium to high plastic, firm to hard, and brown.

## 4.2.4 Clay Till

Clay till was encountered below the clay fill or clay at most borehole locations, extending to the maximum termination depths. The clay till was described as silty, some sand (occasional trace sand), trace gravel, moist to very moist, medium plastic (occasional high plastic), stiff to hard, and brown with coal and oxide specks. Moisture contents of clay till samples ranged between 14% and 29%.

## 4.3 Groundwater Conditions

At the time of drilling, no seepage and minor sloughing was generally encountered at the borehole locations. The groundwater level was measured on August 31, 2015. Table A summarizes the groundwater monitoring data.

**Table A: Groundwater Measurement Results – August 31, 2015**

Borehole Number	Depth of Standpipe (m)	Depth to Groundwater (m)
15BH011	3.0	2.03
15BH030	2.0	1.52
15BH042	2.0	1.88

The local groundwater levels generally represent perched groundwater within sandy inclusions and/or sand lenses within the clay fill and/or clay and clay till deposits and normally fluctuate seasonally and in response to climatic conditions.

## 5.0 GEOTECHNICAL RECOMMENDATIONS

### 5.1 General

All construction recommendations presented in this report are based on the assumption that an adequate level of monitoring will be provided during construction and that all construction will be carried out by a suitably qualified Contractor, experienced in earthworks construction. An adequate level of monitoring for earthworks construction is considered to be full-time monitoring, compaction testing, and laboratory materials analyses.

All such monitoring should be carried out by suitably qualified persons, independent of the Contractor. One of the purposes of providing an adequate level of monitoring is to check that recommendations, based on data obtained at discrete borehole locations, is relevant to other areas along the proposed roadway reconstruction.

### 5.2 Subgrade Conditions

As discussed in Section 4.2, the subgrade soils are generally medium plastic clay soils which are in moist to very moist conditions with firm to very stiff consistency. The subgrade conditions are considered acceptable to support the roadway structure for the medium-term reconstruction (i.e., design life of 10 to 20 years). For a long-term solution (>20 year design life), a minimum 300 mm subgrade preparation should be conducted, including removal of clay containing organics and/or oil. Local repair of soft subgrade areas (if encountered) may be necessary.

### 5.3 Base Gravel Conditions

It is noted that the gravel layer under the bituminous surfacing or exposed at the surface is generally in a loose to compact condition and very variable in thickness. Gravel with more than 40% clay component by weight (classified as clay fill with some gravel or gravelly) was also encountered under the bituminous surfacing at some locations. Such base gravel conditions are not considered acceptable for long-term support for the proposed bituminous surfacing without modifications, which may include adding base gravel and/or replacement of the existing gravel (partially or fully), depending on final grade elevation requirements.

### 5.4 Pavement Design and Improvement Options

The following preliminary design options for replacement pavement sections are provided for this development. It is assumed that the roadways will meet a “Local” classification, or equivalent (City of Lethbridge Design Standards 2014 definitions or equivalent). A detailed traffic study and pavement analysis has not been requested at this time.

With all options, it is imperative that positive surface drainage of both subgrade and asphalt surfacing be maintained. All joints must be sealed to prevent ponding of water and reduce infiltration. Special care and attention should be given to surface grading and sealing of joints at intersections where stormwater is directed over the roadway. Recommended minimum grades of 1.0% should be used in hard surfaced areas.

All asphalt paving lifts should be compacted to a minimum of Marshall Design density, as per current City of Lethbridge Design Standards.

In all cases, full removal of the existing bituminous surface is recommended. Recycling the bituminous surfacing material is not recommended. Replacement asphalt should comprise new material only, sourced from a reputable contractor with experience in asphalt pavement construction.

The parking area and roadway base course should comprise a layer of compacted cement stabilized aggregate or crushed gravel of nominal size equal to 20 mm placed on top of the compacted subgrade. The base course should have a compacted thickness of not less than 100 mm. The base course should be compacted to not less than 100% of maximum density.

The surface of the final lift of base course must have an asphalt prime coat of SS-1, or its equivalent, applied prior to the placement of asphaltic concrete.

The asphalt thickness is dependent on asphalt mix specifications and should be reviewed when details of the mix are available. Minimum surface lift thickness in multiple-lift construction should be not less than 50 mm.

Preparation of the subgrade should be carried out within restricted areas. This is to avoid loosening of the prepared areas by site traffic before compaction of the subgrade and placement of the granular material has been completed. Protection of the prepared subgrade against precipitation and frost should be undertaken.

Observation of compaction and asphalt laying operations should be carried out by staff of Tetra Tech EBA.

#### 5.4.1 Full-Depth Replacement of Pavement (Long-Term Option)

The long-term option includes:

- Complete removal of the existing bituminous surfacing.
- Distribute the existing gravel base material along the road to even out areas with no gravel. Scarify to 300 mm depth, mixing the existing gravel into the clay subgrade to act as a subgrade stabilizer. Areas where the clay subgrade has a high concentration of oil and/or organics should be removed and replaced with clean, cohesive general engineered fill. The subgrade should be moisture conditioned to within 2% of Optimum Moisture Content (OMC), and compacted to 98% of Standard Proctor Maximum Dry Density (SPD). Additional recommendations for subgrade preparation are provided in Section 5.6.
- The prepared subgrade should be proof-rolled to identify any soft areas. Soft areas may require removal of up to 600 mm and should be replaced with general engineered fill.
- Apply compacted granular base and sub-base materials, followed by the new asphalt concrete surfacing. For this option, a hot mix Type III Asphalt Concrete is recommended, but a cold mix may also be considered. The recommended pavement structure may be considered as follows (Table B).

<b>Table B: Long-Term Option</b>		
<b>Material Type</b>	<b>Local Equivalent (mm)</b>	<b>Heavy Duty / Industrial Equivalent (mm)</b>
Cold Mix Asphalt or Type III HMA Surface	75	100
Granular Base Course	200	200
Granular Sub-base	-	200
Subgrade Preparation	300	300

The above-recommended pavement layer thicknesses generally refer to average values and recognize typical construction variability. The final thickness of the sub-base granular should be field confirmed, based on the subgrade conditions encountered at the time of development.

This option is recommended as the preferred option for long-term performance. This is intended to be a permanent solution for a design service life of over 20 years. The final service life will depend on having an effective maintenance program in place to seal cracks and joints, repair potholes, etc.

Tetra Tech EBA recommends a review of the pavement section be undertaken once final traffic loading conditions and the functional aspects of the traffic areas are known.

### 5.4.2 Partial Replacement of Pavement (Medium-Term Option)

The medium-term option includes:

- Complete removal of existing bituminous surfacing.
- Proof-roll the underlying granular base (or clay subgrade where no granular base material is present) to identify soft areas. Where encountered, soft areas may need to be subcut up to 600 mm and reworked to achieve compaction at 98% of SPD and moisture within 2% of OMC.
- Apply granular base material where none is existing, to achieve at least 200 mm minimum compacted thickness in all areas (300 mm where heavy truck traffic is expected). Removal of clay subgrade may be necessary in some areas to maintain proper grading before granular base material is added.
- The recommended pavement structure may be considered as follows (Table C).

<b>Table C: Medium-Term Option</b>		
<b>Material Type</b>	<b>Local Equivalent (mm)</b>	<b>Heavy Duty / Industrial Equivalent (mm)</b>
Cold Mix Asphalt Surface	75	100
Granular Base Course (new or existing material)	200	300

This option is also considered a permanent solution, with a design service life of 10 to 20 years. The final service life will depend on having an effective maintenance program in place to seal cracks and joints, repair potholes, etc.

### 5.5 Backfill Materials

The existing site soils, comprising clean, medium plastic clay fill are adequate for use as 'general engineered fill', as defined in Appendix C, for roadway subgrade preparation. The clay fill with some gravel or gravelly, were not suitable as sub-base granular materials and can only be used for subgrade soils.

The earthwork contractor should make his/her own estimate of the requirements for moisture conditioning to the recommended standards, and should consider such factors as weather and construction procedures.

Further recommendations regarding backfill materials and compaction are contained in Appendix C.

### 5.6 Roadway Subgrade Preparation

Based on Tetra Tech EBA's experience in this area, the recommended subgrade preparation is compaction to a minimum of 98% of SPD. Clay soils should be compacted with a moisture content within 2% of OMC. Proof-rolling of the entire surface area under pavement sections should be carried out to detect any local soft spots. Soft spots detected as a result of proof-rolling should be excavated and backfilled with 'general engineered fill'.

Where soft subgrade conditions exist below the design subgrade elevation, these areas may have to be subexcavated and replaced with general engineered fill materials. In areas where subgrade materials contain organics, high concentrations of oil, or other deleterious materials, the unsuitable subgrade soils should be removed and replaced with clean general engineered fill. Depth of removal may need to be reviewed by a qualified engineer during construction.

Proof-rolling of the prepared surface is recommended to identify localized soft areas and for an indication of overall subgrade support characteristics. Options for subgrade improvements are normally field determined based on the results of the proof-roll. However, based on Tetra Tech EBA's experience, subgrade improvement measures may include placing a bridging layer of better quality soil within 0.6 m of design surface subgrade elevation (possibly imported), compacted as noted above.

It is recommended to include a contingency for geotextile, should localized areas of subgrade instability be encountered. Use of geotextile should be considered as an alternative, should subgrade instability exist after subgrade preparation.

The subgrade must be graded to allow drainage toward the shoulders and into drainage ditches.

## **6.0 DESIGN AND CONSTRUCTION GUIDELINES**

General design and construction guidelines are provided in Appendix C, under the following supplemental heading:

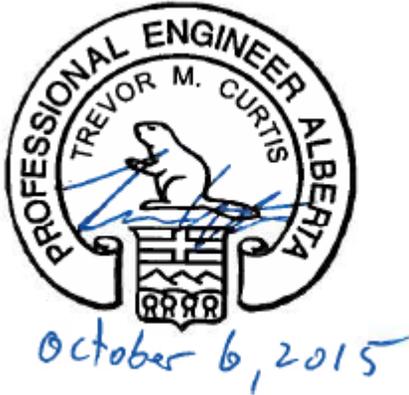
- **Backfill Materials and Compaction**

These guidelines are intended to present standards of good practice. Although supplemental to the main text of this report, they should be interpreted as part of the report. Design recommendations presented herein are based on the premise that these guidelines will be followed. The design and construction guidelines are not intended to represent detailed specifications for the works although they may prove useful in the preparation of such specifications. In the event of any discrepancy between the main text of this report and Appendix C, the main text should govern.

## 7.0 CLOSURE

We trust this report meets your present requirements. If you have any questions or comments, please contact the undersigned.

Respectfully submitted,  
Tetra Tech EBA Inc.



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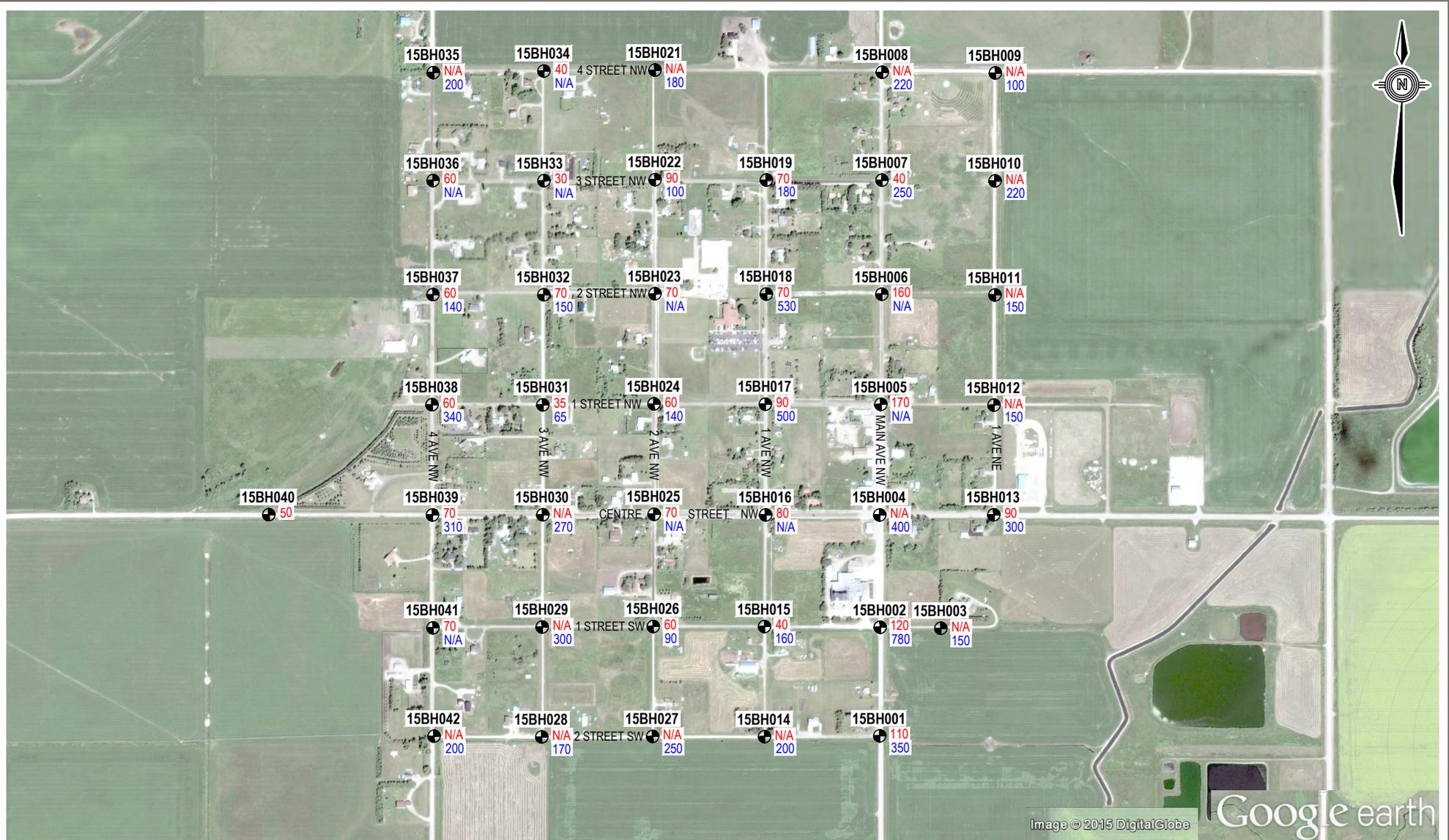
<b>PERMIT TO PRACTICE</b> TETRA TECH EBA, INC.	
Signature	<u><i>M. Curtis</i></u>
Date	<u>OCT 6, 2015</u>
<b>PERMIT NUMBER: P245</b> The Association of Professional Engineers and Geoscientists of Alberta	

# FIGURES

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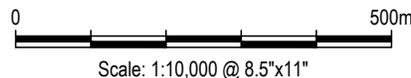
Figure 1      Borehole Location Plan





**LEGEND**

-  BOREHOLE LOCATION
- 100 ASPHALT THICKNESS (mm)
- 100 GRAVEL THICKNESS (mm)
- N/A NO GRAVEL OR ASPHALT AVAILABLE



**NOTES**  
BASE IMAGE PROVIDED BY  
GOOGLE EARTH, CIRCA 2013

**CLIENT**

**Village of Glenwood**



**VILLAGE OF GLENWOOD ROADWAYS  
GLENWOOD, ALBERTA**

**SITE PLAN**

PROJECT NO. L12103982-01	DWN LCH	CKD SS	REV 0
OFFICE LETHBRIDGE	DATE September 2015		

**Figure 1**



# APPENDIX A

## GEOTECHNICAL REPORT - GENERAL CONDITIONS

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# GENERAL CONDITIONS

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## GEOTECHNICAL REPORT

This report incorporates and is subject to these “General Conditions”.

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### 1.0 USE OF REPORT AND OWNERSHIP

This geotechnical report pertains to a specific site, a specific development and a specific scope of work. It is not applicable to any other sites nor should it be relied upon for types of development other than that to which it refers. Any variation from the site or development would necessitate a supplementary geotechnical assessment.

This report and the recommendations contained in it are intended for the sole use of Tetra Tech EBA's Client. Tetra Tech EBA does not accept any responsibility for the accuracy of any of the data, the analyses or the recommendations contained or referenced in the report when the report is used or relied upon by any party other than Tetra Tech EBA's Client unless otherwise authorized in writing by Tetra Tech EBA. Any unauthorized use of the report is at the sole risk of the user.

This report is subject to copyright and shall not be reproduced either wholly or in part without the prior, written permission of Tetra Tech EBA. Additional copies of the report, if required, may be obtained upon request.

### 2.0 ALTERNATE REPORT FORMAT

Where Tetra Tech EBA submits both electronic file and hard copy versions of reports, drawings and other project-related documents and deliverables (collectively termed Tetra Tech EBA's instruments of professional service), only the signed and/or sealed versions shall be considered final and legally binding. The original signed and/or sealed version archived by Tetra Tech EBA shall be deemed to be the original for the Project.

Both electronic file and hard copy versions of Tetra Tech EBA's instruments of professional service shall not, under any circumstances, no matter who owns or uses them, be altered by any party except Tetra Tech EBA. Tetra Tech EBA's instruments of professional service will be used only and exactly as submitted by Tetra Tech EBA.

Electronic files submitted by Tetra Tech EBA have been prepared and submitted using specific software and hardware systems. Tetra Tech EBA makes no representation about the compatibility of these files with the Client's current or future software and hardware systems.

### 3.0 ENVIRONMENTAL AND REGULATORY ISSUES

Unless stipulated in the report, Tetra Tech EBA has not been retained to investigate, address or consider and has not investigated, addressed or considered any environmental or regulatory issues associated with development on the subject site.

### 4.0 NATURE AND EXACTNESS OF SOIL AND ROCK DESCRIPTIONS

Classification and identification of soils and rocks are based upon commonly accepted systems and methods employed in professional geotechnical practice. This report contains descriptions of the systems and methods used. Where deviations from the system or method prevail, they are specifically mentioned.

Classification and identification of geological units are judgmental in nature as to both type and condition. Tetra Tech EBA does not warrant conditions represented herein as exact, but infers accuracy only to the extent that is common in practice.

Where subsurface conditions encountered during development are different from those described in this report, qualified geotechnical personnel should revisit the site and review recommendations in light of the actual conditions encountered.

### 5.0 LOGS OF TESTHOLES

The testhole logs are a compilation of conditions and classification of soils and rocks as obtained from field observations and laboratory testing of selected samples. Soil and rock zones have been interpreted. Change from one geological zone to the other, indicated on the logs as a distinct line, can be, in fact, transitional. The extent of transition is interpretive. Any circumstance which requires precise definition of soil or rock zone transition elevations may require further investigation and review.

### 6.0 STRATIGRAPHIC AND GEOLOGICAL INFORMATION

The stratigraphic and geological information indicated on drawings contained in this report are inferred from logs of testholes and/or soil/rock exposures. Stratigraphy is known only at the locations of the testhole or exposure. Actual geology and stratigraphy between testholes and/or exposures may vary from that shown on these drawings. Natural variations in geological conditions are inherent and are a function of the historic environment. Tetra Tech EBA does not represent the conditions illustrated as exact but recognizes that variations will exist. Where knowledge of more precise locations of geological units is necessary, additional investigation and review may be necessary.

## **7.0 PROTECTION OF EXPOSED GROUND**

Excavation and construction operations expose geological materials to climatic elements (freeze/thaw, wet/dry) and/or mechanical disturbance which can cause severe deterioration. Unless otherwise specifically indicated in this report, the walls and floors of excavations must be protected from the elements, particularly moisture, desiccation, frost action and construction traffic.

## **8.0 SUPPORT OF ADJACENT GROUND AND STRUCTURES**

Unless otherwise specifically advised, support of ground and structures adjacent to the anticipated construction and preservation of adjacent ground and structures from the adverse impact of construction activity is required.

## **9.0 INFLUENCE OF CONSTRUCTION ACTIVITY**

There is a direct correlation between construction activity and structural performance of adjacent buildings and other installations. The influence of all anticipated construction activities should be considered by the contractor, owner, architect and prime engineer in consultation with a geotechnical engineer when the final design and construction techniques are known.

## **10.0 OBSERVATIONS DURING CONSTRUCTION**

Because of the nature of geological deposits, the judgmental nature of geotechnical engineering, as well as the potential of adverse circumstances arising from construction activity, observations during site preparation, excavation and construction should be carried out by a geotechnical engineer. These observations may then serve as the basis for confirmation and/or alteration of geotechnical recommendations or design guidelines presented herein.

## **11.0 DRAINAGE SYSTEMS**

Where temporary or permanent drainage systems are installed within or around a structure, the systems which will be installed must protect the structure from loss of ground due to internal erosion and must be designed so as to assure continued performance of the drains. Specific design detail of such systems should be developed or reviewed by the geotechnical engineer. Unless otherwise specified, it is a condition of this report that effective temporary and permanent drainage systems are required and that they must be considered in relation to project purpose and function.

## **12.0 BEARING CAPACITY**

Design bearing capacities, loads and allowable stresses quoted in this report relate to a specific soil or rock type and condition. Construction activity and environmental circumstances can materially change the condition of soil or rock. The elevation at which a soil or rock type occurs is variable. It is a requirement of this report that structural elements be founded in and/or upon geological materials of the type and in the condition assumed. Sufficient observations should be made by qualified geotechnical personnel during construction to assure that the soil and/or rock conditions assumed in this report in fact exist at the site.

## **13.0 SAMPLES**

Tetra Tech EBA will retain all soil and rock samples for 30 days after this report is issued. Further storage or transfer of samples can be made at the Client's expense upon written request, otherwise samples will be discarded.

## **14.0 INFORMATION PROVIDED TO TETRA TECH EBA BY OTHERS**

During the performance of the work and the preparation of the report, Tetra Tech EBA may rely on information provided by persons other than the Client. While Tetra Tech EBA endeavours to verify the accuracy of such information when instructed to do so by the Client, Tetra Tech EBA accepts no responsibility for the accuracy or the reliability of such information which may affect the report.

# APPENDIX B

## BOREHOLE LOGS

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## TERMS USED ON BOREHOLE LOGS

### TERMS DESCRIBING CONSISTENCY OR CONDITION

**COARSE GRAINED SOILS** (major portion retained on 0.075mm sieve): Includes (1) clean gravels and sands, and (2) silty or clayey gravels and sands. Condition is rated according to relative density, as inferred from laboratory or in situ tests.

DESCRIPTIVE TERM	RELATIVE DENSITY	N (blows per 0.3m)
Very Loose	0 TO 20%	0 to 4
Loose	20 TO 40%	4 to 10
Compact	40 TO 75%	10 to 30
Dense	75 TO 90%	30 to 50
Very Dense	90 TO 100%	greater than 50

The number of blows, N, on a 51mm O.D. split spoon sampler of a 63.5kg weight falling 0.76m, required to drive the sampler a distance of 0.3m from 0.15m to 0.45m.

**FINE GRAINED SOILS** (major portion passing 0.075mm sieve): Includes (1) inorganic and organic silts and clays, (2) gravelly, sandy, or silty clays, and (3) clayey silts. Consistency is rated according to shearing strength, as estimated from laboratory or in situ tests.

DESCRIPTIVE TERM	UNCONFINED COMPRESSIVE STRENGTH (KPA)
Very Soft	Less than 25
Soft	25 to 50
Firm	50 to 100
Stiff	100 to 200
Very Stiff	200 to 400
Hard	Greater than 400

**NOTE:** Slickensided and fissured clays may have lower unconfined compressive strengths than shown above, because of planes of weakness or cracks in the soil.

### GENERAL DESCRIPTIVE TERMS

**Slickensided** - having inclined planes of weakness that are slick and glossy in appearance.

**Fissured** - containing shrinkage cracks, frequently filled with fine sand or silt; usually more or less vertical.

**Laminated** - composed of thin layers of varying colour and texture.

**Interbedded** - composed of alternate layers of different soil types.

**Calcareous** - containing appreciable quantities of calcium carbonate.;

**Well graded** - having wide range in grain sizes and substantial amounts of intermediate particle sizes.

**Poorly graded** - predominantly of one grain size, or having a range of sizes with some intermediate size missing.

# MODIFIED UNIFIED SOIL CLASSIFICATION

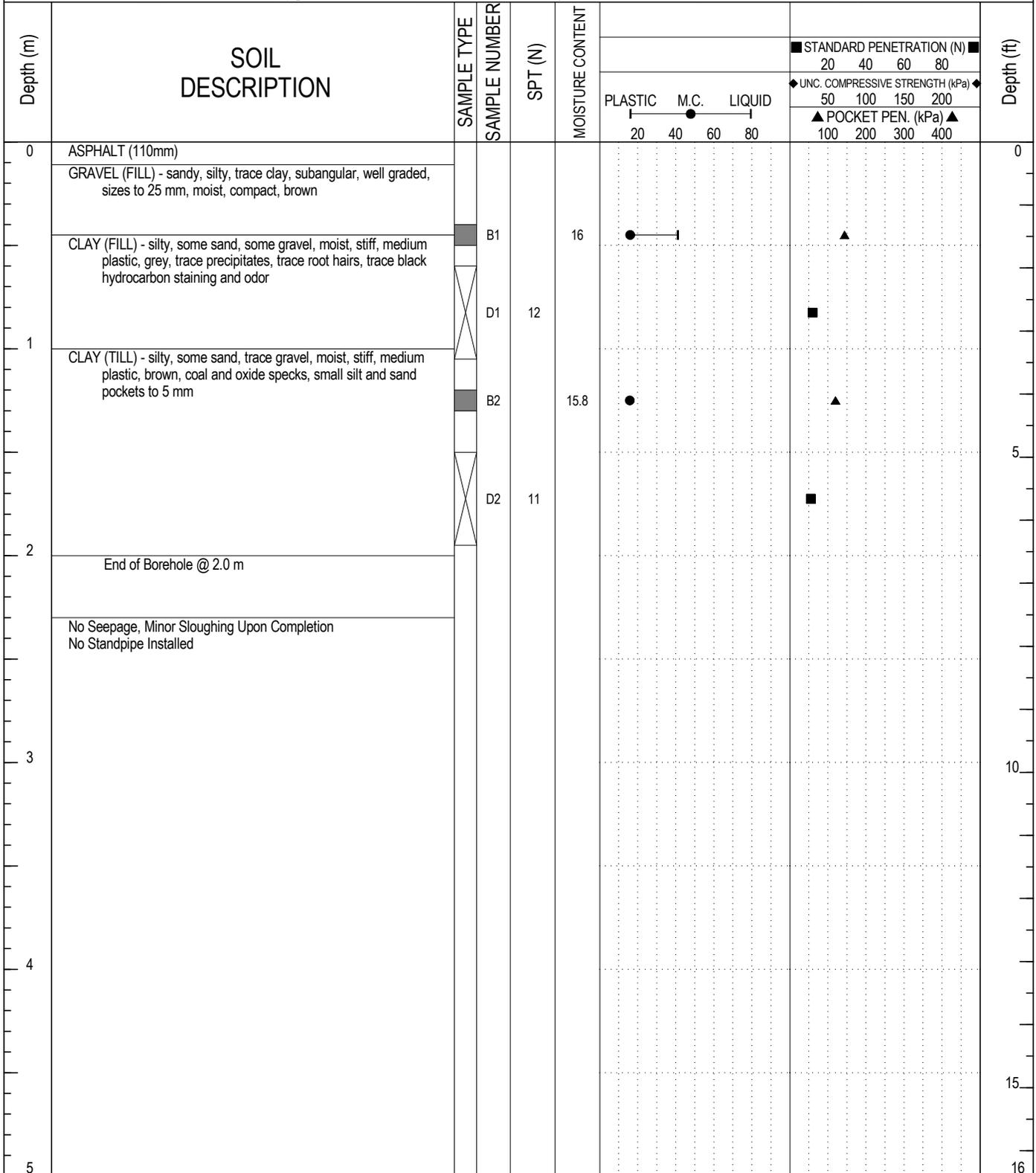
MAJOR DIVISION		GROUP SYMBOL	TYPICAL DESCRIPTION	LABORATORY CLASSIFICATION CRITERIA			
<b>COARSE-GRAINED SOILS</b> More than 50% retained on 75 µm sieve*	<b>GRAVELS</b> 50% or more of coarse fraction retained on 4.75 mm sieve	CLEAN GRAVELS	GW	Well-graded gravels and gravel-sand mixtures, little or no fines	$C_u = D_{60} / D_{10}$ Greater than 4 $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ Between 1 and 3 Not meeting both criteria for GW		
		GRAVELS WITH FINES	GP	Poorly graded gravels and gravel-sand mixtures, little or no fines			
		<b>SANDS</b> More than 50% of coarse fraction passes 4.75 mm sieve	CLEAN SANDS	GM		Silty gravels, gravel-sand-silt mixtures	Atterberg limits plot below "A" line or plasticity index less than 4 Atterberg limits plotting in hatched area are borderline classifications requiring use of dual symbols
			SANDS WITH FINES	GC		Clayey gravels, gravel-sand-clay mixtures	
	<b>FINE-GRAINED SOILS (by behavior)</b> 50% or more passes 75 µm sieve*	<b>SILTS</b> Liquid limit	<50	ML	Inorganic silts, very fine sands, rock flour, silty or clayey fine sands of slight plasticity	For classification of fine-grained soils and fine fraction of coarse-grained soils. <div style="text-align: center;"> <b>PLASTICITY CHART</b> </div>	
			>50	MH	Inorganic silts, micaceous or diatomaceous fine sands or silts, elastic silts		
		<b>CLAYS</b> Above "A" line on plasticity chart negligible organic content Liquid limit	<30	CL	Inorganic clays of low plasticity, gravelly clays, sandy clays, silty clays, lean clays		
			30-50	CI	Inorganic clays of medium plasticity, silty clays		
			>50	CH	Inorganic clays of high plasticity, fat clays		
		<b>ORGANIC SILTS AND CLAYS</b> Liquid limit	<50	OL	Organic silts and organic silty clays of low plasticity		
>50	OH		Organic clays of medium to high plasticity				
<b>HIGHLY ORGANIC SOILS</b>		PT	Peat and other highly organic soils	*Based on the material passing the 75 mm sieve Reference: ASTM Designation D2487, for identification procedure see D2488. USC as modified by PFRA			

SOIL COMPONENTS					OVERSIZE MATERIAL	
FRACTION	SIEVE SIZE		DEFINING RANGES OF PERCENTAGE BY MASS OF MINOR COMPONENTS		Rounded or subrounded COBBLES 75 mm to 300 mm BOULDERS > 300 mm	
	PASSING	RETAINED	PERCENTAGE	DESCRIPTOR		
GRAVEL coarse fine	75 mm 19 mm	19 mm	>35 %	"and"	Not rounded ROCK FRAGMENTS >75 mm ROCKS > 0.76 cubic metre in volume	
		4.75 mm	21 to 35 %	"y-adjective"		
SAND coarse medium fine	4.75 mm 2.00 mm 425 µm	2.00 mm	10 to 20 %	"some"		
		425 µm	>0 to 10 %	"trace"		
		75 µm		as above but by behavior		

Tt\_Modified Unified Soil Classification.cdr

PROJECT: VILLAGE OF GLENWOOD ROADWAYS	CLIENT: VILLAGE OF GLENWOOD	BOREHOLE NO: 15BH001
LOCATION: ALL INTERSECTIONS IN TOWN	DRILL METHOD: 150mm SOLID STEM AUGER	PROJECT: L12103982-01
CITY: GLENWOOD, AB	N - 5470502, E - 317697	

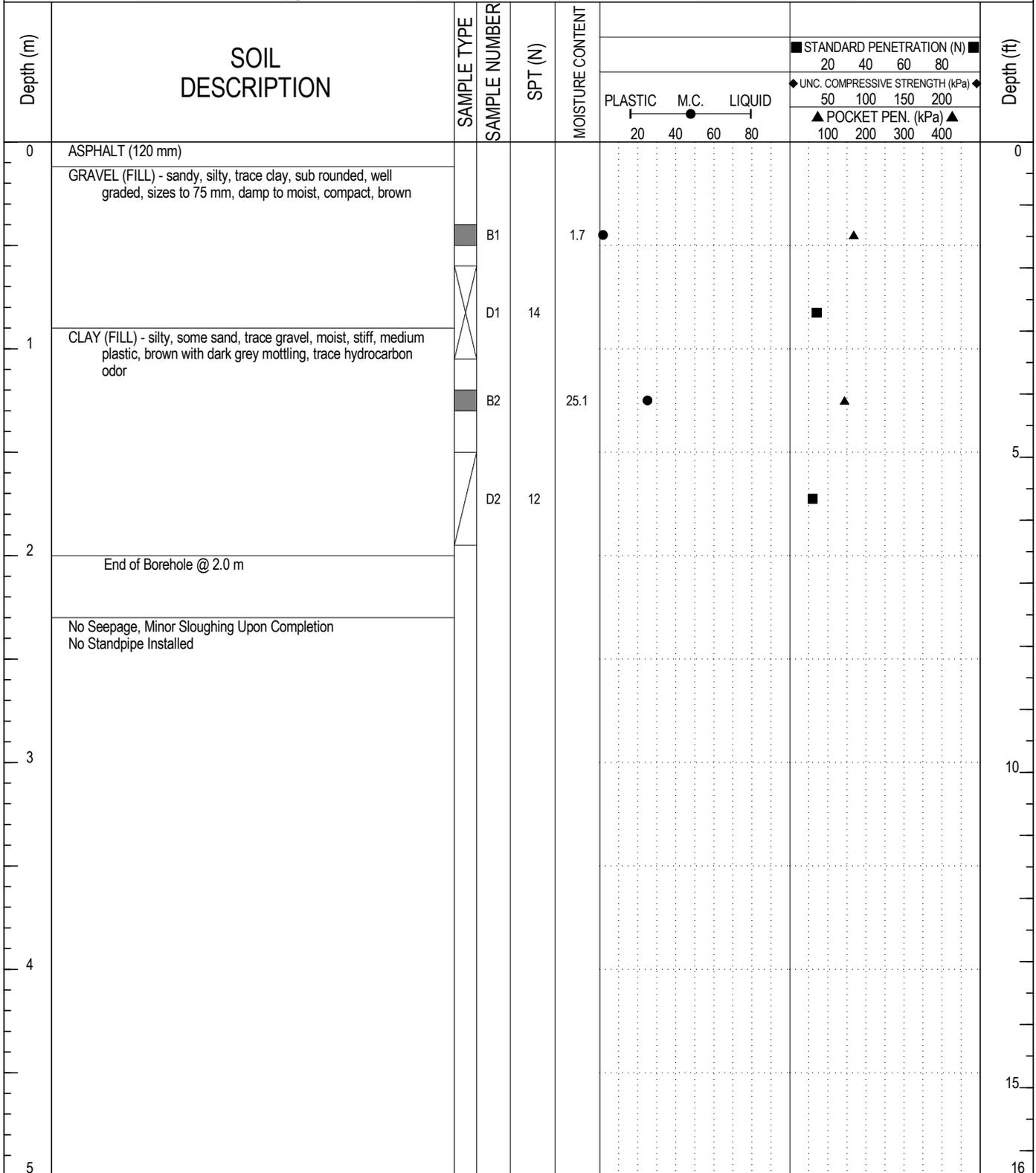
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BACKFILL TYPE	<input checked="" type="checkbox"/> BENTONITE	<input type="checkbox"/> PEA GRAVEL	<input type="checkbox"/> SLOUGH	<input type="checkbox"/> GROUT	<input type="checkbox"/> DRILL CUTTINGS	<input type="checkbox"/> SAND



LOGGED BY: SS	COMPLETION DEPTH: 2 m
REVIEWED BY: JZ	COMPLETE: 8/20/2015
DRAWING NO: B1	Page 1 of 1

PROJECT: VILLAGE OF GLENWOOD ROADWAYS	CLIENT: VILLAGE OF GLENWOOD	BOREHOLE NO: 15BH002
LOCATION: ALL INTERSECTIONS IN TOWN	DRILL METHOD: 150mm SOLID STEM AUGER	PROJECT: L12103982-01
CITY: GLENWOOD, AB	N - 5470697, E - 317700	

SAMPLE TYPE	<input checked="" type="checkbox"/> DISTURBED	<input type="checkbox"/> NO RECOVERY	<input checked="" type="checkbox"/> SPT	<input type="checkbox"/> A-CASING	<input type="checkbox"/> SHELBY TUBE	<input type="checkbox"/> CORE
BACKFILL TYPE	<input checked="" type="checkbox"/> BENTONITE	<input type="checkbox"/> PEA GRAVEL	<input type="checkbox"/> SLOUGH	<input type="checkbox"/> GROUT	<input type="checkbox"/> DRILL CUTTINGS	<input type="checkbox"/> SAND



 <b>TETRA TECH EBA</b>	LOGGED BY: SS	COMPLETION DEPTH: 2 m
	REVIEWED BY: JZ	COMPLETE: 8/20/2015
	DRAWING NO: B2	Page 1 of 1

PROJECT: VILLAGE OF GLENWOOD ROADWAYS	CLIENT: VILLAGE OF GLENWOOD	BOREHOLE NO: 15BH003
LOCATION: ALL INTERSECTIONS IN TOWN	DRILL METHOD: 150mm SOLID STEM AUGER	PROJECT: L12103982-01
CITY: GLENWOOD, AB	N - 5470702, E - 317787	

SAMPLE TYPE	<input checked="" type="checkbox"/> DISTURBED	<input type="checkbox"/> NO RECOVERY	<input checked="" type="checkbox"/> SPT	<input type="checkbox"/> A-CASING	<input type="checkbox"/> SHELBY TUBE	<input type="checkbox"/> CORE
BACKFILL TYPE	<input checked="" type="checkbox"/> BENTONITE	<input type="checkbox"/> PEA GRAVEL	<input type="checkbox"/> SLOUGH	<input type="checkbox"/> GROUT	<input type="checkbox"/> DRILL CUTTINGS	<input type="checkbox"/> SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	SPT (N)	MOISTURE CONTENT	PLASTICITY INDEX			Depth (ft)
						PLASTIC	M.C.	LIQUID	
0	GRAVEL (FILL) - sandy, silty, trace clay, subrounded, well graded, damp to moist, compact, brown CLAY (FILL) - silty, some sand, trace gravel, moist, very stiff, medium plastic, brown with dark brown mottling, roots, organics, trace precipitates	<input checked="" type="checkbox"/>	B1	16.4	●				0
1		<input checked="" type="checkbox"/>	D1	34					
		<input checked="" type="checkbox"/>	B2	17.2	●				
2	CLAY (TILL) - silty, some sand, trace gravel, moist, very stiff, medium plastic, brown, coal and oxide specks, small silt and sand pockets End of Borehole @ 2.0 m	<input checked="" type="checkbox"/>	D2	27					
3	No Seepage, Minor Sloughing Upon Completion No Standpipe Installed								
4									
5									

 <b>TETRA TECH EBA</b>	LOGGED BY: SS	COMPLETION DEPTH: 2 m
	REVIEWED BY: JZ	COMPLETE: 8/25/2015
	DRAWING NO: B3	Page 1 of 1

PROJECT: VILLAGE OF GLENWOOD ROADWAYS	CLIENT: VILLAGE OF GLENWOOD	BOREHOLE NO: 15BH004
LOCATION: ALL INTERSECTIONS IN TOWN	DRILL METHOD: 150mm SOLID STEM AUGER	PROJECT: L12103982-01
CITY: GLENWOOD, AB	N - 5470903, E - 317704	

SAMPLE TYPE	<input checked="" type="checkbox"/> DISTURBED	<input type="checkbox"/> NO RECOVERY	<input checked="" type="checkbox"/> SPT	<input type="checkbox"/> A-CASING	<input type="checkbox"/> SHELBY TUBE	<input type="checkbox"/> CORE
BACKFILL TYPE	<input checked="" type="checkbox"/> BENTONITE	<input type="checkbox"/> PEA GRAVEL	<input type="checkbox"/> SLOUGH	<input type="checkbox"/> GROUT	<input type="checkbox"/> DRILL CUTTINGS	<input type="checkbox"/> SAND

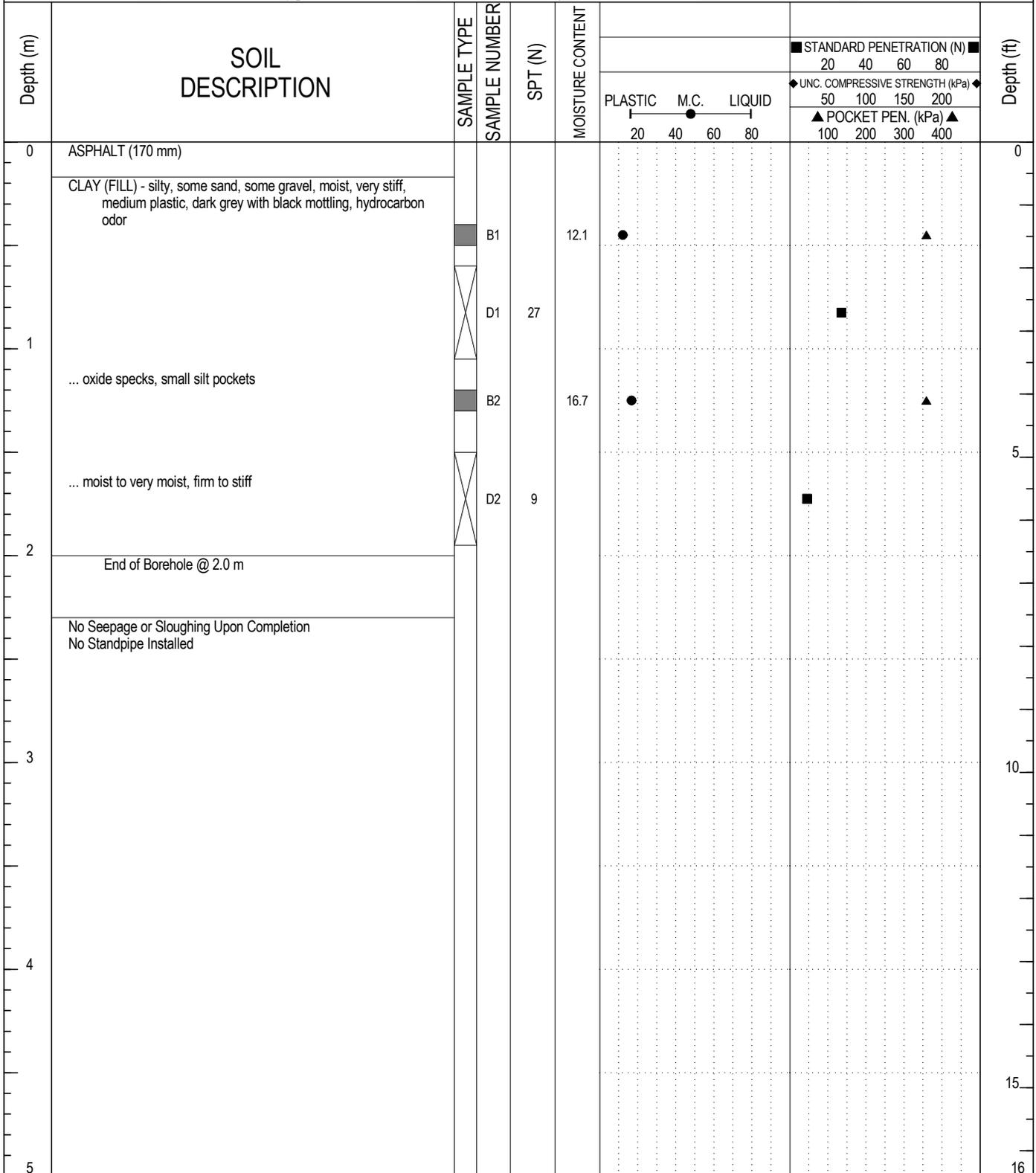
Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	SPT (N)	MOISTURE CONTENT	PLASTICITY			STANDARD PENETRATION (N)	UNC. COMPRESSIVE STRENGTH (kPa)	POCKET PEN. (kPa)	Depth (ft)
						PLASTIC	M.C.	LIQUID				
0	GRAVEL (FILL) - sandy, silty, trace clay, subrounded, well graded, sizes to 25 mm, moist, compact, brown											0
	CLAY (FILL) - silty, gravelly, some sand, moist, stiff, low plastic, dark grey with black mottling, hydrocarbon odor, root hairs	<input checked="" type="checkbox"/>	B1	11.8	●				▲			
1	... some gravel, medium plastic, black	<input type="checkbox"/>	D1	14					■			
		<input checked="" type="checkbox"/>	B2	11.6	●				▲			
2	End of Borehole @ 2.0 m	<input type="checkbox"/>	D2	11					■			
	No Seepage, Minor Sloughing Upon Completion No Standpipe Installed											
3												10
4												15
5												16



LOGGED BY: SS	COMPLETION DEPTH: 2 m
REVIEWED BY: JZ	COMPLETE: 8/20/2015
DRAWING NO: B4	Page 1 of 1

PROJECT: VILLAGE OF GLENWOOD ROADWAYS	CLIENT: VILLAGE OF GLENWOOD	BOREHOLE NO: 15BH005
LOCATION: ALL INTERSECTIONS IN TOWN	DRILL METHOD: 150mm SOLID STEM AUGER	PROJECT: L12103982-01
CITY: GLENWOOD, AB	N - 5471104, E - 317717	

SAMPLE TYPE	<input checked="" type="checkbox"/> DISTURBED	<input type="checkbox"/> NO RECOVERY	<input checked="" type="checkbox"/> SPT	<input type="checkbox"/> A-CASING	<input type="checkbox"/> SHELBY TUBE	<input type="checkbox"/> CORE
BACKFILL TYPE	<input checked="" type="checkbox"/> BENTONITE	<input type="checkbox"/> PEA GRAVEL	<input type="checkbox"/> SLOUGH	<input type="checkbox"/> GROUT	<input type="checkbox"/> DRILL CUTTINGS	<input type="checkbox"/> SAND



LOGGED BY: SS	COMPLETION DEPTH: 2 m
REVIEWED BY: JZ	COMPLETE: 8/20/2015
DRAWING NO: B5	Page 1 of 1

PROJECT: VILLAGE OF GLENWOOD ROADWAYS	CLIENT: VILLAGE OF GLENWOOD	BOREHOLE NO: 15BH006
LOCATION: ALL INTERSECTIONS IN TOWN	DRILL METHOD: 150mm SOLID STEM AUGER	PROJECT: L12103982-01
CITY: GLENWOOD, AB	N - 5471303, E - 317728	

SAMPLE TYPE	<input checked="" type="checkbox"/> DISTURBED	<input type="checkbox"/> NO RECOVERY	<input checked="" type="checkbox"/> SPT	<input type="checkbox"/> A-CASING	<input type="checkbox"/> SHELBY TUBE	<input type="checkbox"/> CORE
BACKFILL TYPE	<input checked="" type="checkbox"/> BENTONITE	<input type="checkbox"/> PEA GRAVEL	<input type="checkbox"/> SLOUGH	<input type="checkbox"/> GROUT	<input type="checkbox"/> DRILL CUTTINGS	<input type="checkbox"/> SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	SPT (N)	MOISTURE CONTENT	PLASTICITY INDEX			Depth (ft)
						PLASTIC	M.C.	LIQUID	
0	ASPHALT (160 mm)								0
	CLAY (FILL) - silty, some sand, some gravel, moist, hard, medium plastic, dark grey with black mottling, hydrocarbon odor								
	... black								
1		<input checked="" type="checkbox"/>	B1	11	●				
		<input checked="" type="checkbox"/>	D1	40				■	
		<input checked="" type="checkbox"/>	B2	20.8	●				
	CLAY (TILL) - silty, some sand, trace gravel, moist, very stiff, medium plastic, brown, coal and oxide specks, small silt and sand pockets								
2		<input checked="" type="checkbox"/>	D2	26				■	5
	End of Borehole @ 2.0 m								
	No Seepage or Sloughing Upon Completion No Standpipe Installed								
3									10
4									15
5									16

	LOGGED BY: SS	COMPLETION DEPTH: 2 m
	REVIEWED BY: JZ	COMPLETE: 8/25/2015
	DRAWING NO: B6	Page 1 of 1

PROJECT: VILLAGE OF GLENWOOD ROADWAYS	CLIENT: VILLAGE OF GLENWOOD	BOREHOLE NO: 15BH007
LOCATION: ALL INTERSECTIONS IN TOWN	DRILL METHOD: 150mm SOLID STEM AUGER	PROJECT: L12103982-01
CITY: GLENWOOD, AB	N - 5471506, E - 317737	

SAMPLE TYPE	<input checked="" type="checkbox"/> DISTURBED	<input type="checkbox"/> NO RECOVERY	<input checked="" type="checkbox"/> SPT	<input type="checkbox"/> A-CASING	<input type="checkbox"/> SHELBY TUBE	<input type="checkbox"/> CORE
BACKFILL TYPE	<input checked="" type="checkbox"/> BENTONITE	<input type="checkbox"/> PEA GRAVEL	<input type="checkbox"/> SLOUGH	<input type="checkbox"/> GROUT	<input type="checkbox"/> DRILL CUTTINGS	<input type="checkbox"/> SAND

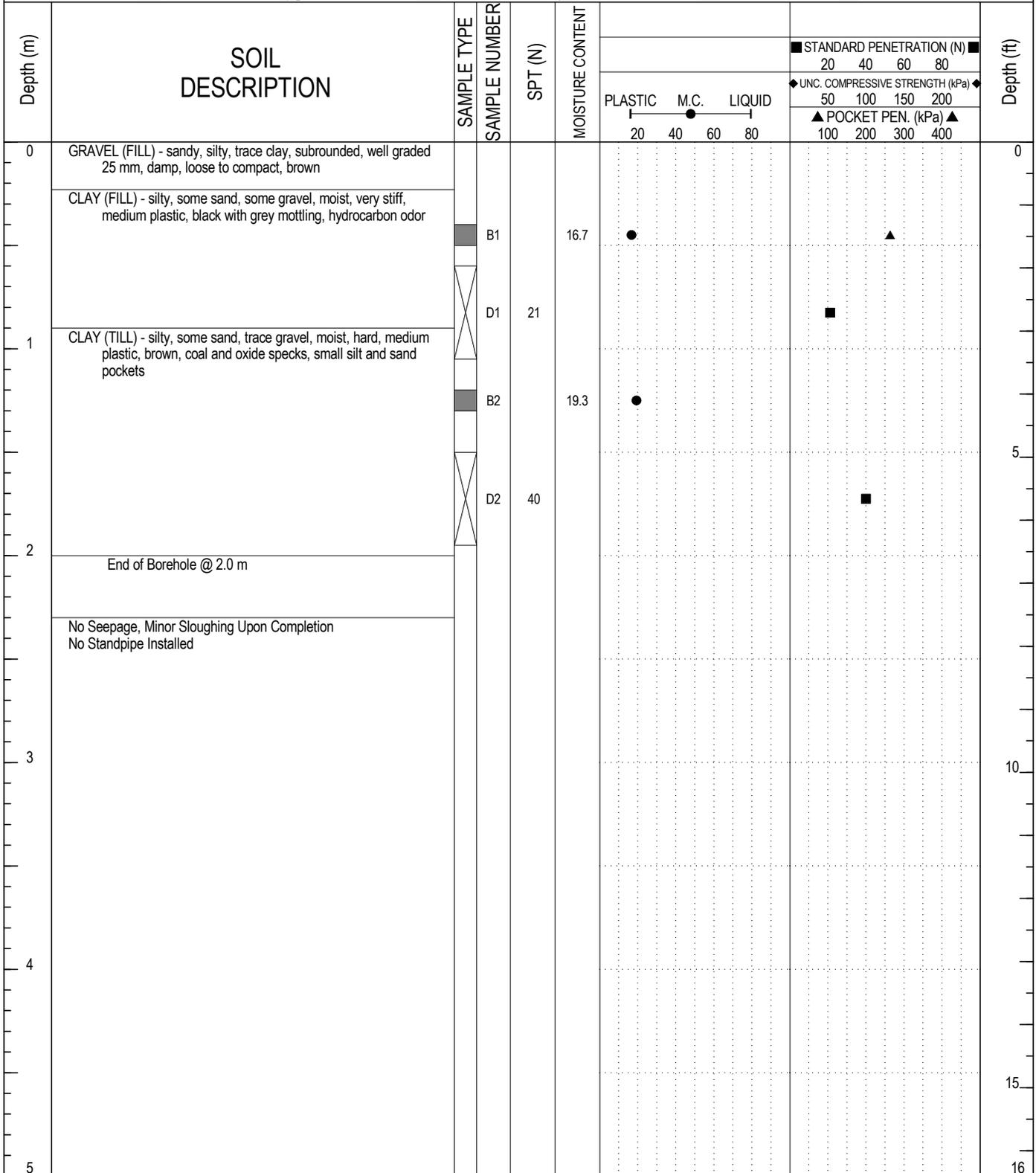
Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	SPT (N)	MOISTURE CONTENT	PLASTICITY INDEX			STANDARD PENETRATION (N)	UNC. COMPRESSIVE STRENGTH (kPa)	POCKET PEN. (kPa)	Depth (ft)
						PLASTIC	M.C.	LIQUID				
0	ASPHALT (40 mm)											0
	GRAVEL (FILL) - sandy, silty, trace clay, subrounded, well graded, sizes to 50 mm, moist, loose to compact, brown											
	CLAY (FILL) - silty, some sand, gravelly, moist, very stiff, low plastic, black with grey mottling, hydrocarbon odor ... trace gravel	<input checked="" type="checkbox"/>	B1	25.4	●						▲	
		<input checked="" type="checkbox"/>	D1	36					■			
	CLAY (TILL) - silty, some sand, trace gravel, moist, very stiff, medium plastic, brown, white precipitates, coal and oxide specks, small silt and sand pockets	<input checked="" type="checkbox"/>	B2	15.9	●						▲	
		<input checked="" type="checkbox"/>	D2	35					■			
2	End of Borehole @ 2.0 m											
	No Seepage, Minor Sloughing Upon Completion No Standpipe Installed											
3												10
4												15
5												16



LOGGED BY: SS	COMPLETION DEPTH: 2 m
REVIEWED BY: JZ	COMPLETE: 8/25/2015
DRAWING NO: B7	Page 1 of 1

PROJECT: VILLAGE OF GLENWOOD ROADWAYS	CLIENT: VILLAGE OF GLENWOOD	BOREHOLE NO: 15BH008
LOCATION: ALL INTERSECTIONS IN TOWN	DRILL METHOD: 150mm SOLID STEM AUGER	PROJECT: L12103982-01
CITY: GLENWOOD, AB	N - 5471710, E - 317729	

SAMPLE TYPE	<input checked="" type="checkbox"/> DISTURBED	<input type="checkbox"/> NO RECOVERY	<input checked="" type="checkbox"/> SPT	<input type="checkbox"/> A-CASING	<input type="checkbox"/> SHELBY TUBE	<input type="checkbox"/> CORE
BACKFILL TYPE	<input checked="" type="checkbox"/> BENTONITE	<input type="checkbox"/> PEA GRAVEL	<input type="checkbox"/> SLOUGH	<input type="checkbox"/> GROUT	<input type="checkbox"/> DRILL CUTTINGS	<input type="checkbox"/> SAND



LOGGED BY: SS	COMPLETION DEPTH: 2 m
REVIEWED BY: JZ	COMPLETE: 8/25/2015
DRAWING NO: B8	Page 1 of 1

PROJECT: VILLAGE OF GLENWOOD ROADWAYS	CLIENT: VILLAGE OF GLENWOOD	BOREHOLE NO: 15BH009
LOCATION: ALL INTERSECTIONS IN TOWN	DRILL METHOD: 150mm SOLID STEM AUGER	PROJECT: L12103982-01
CITY: GLENWOOD, AB	N - 5471699, E - 317933	

SAMPLE TYPE	<input checked="" type="checkbox"/> DISTURBED	<input type="checkbox"/> NO RECOVERY	<input checked="" type="checkbox"/> SPT	<input type="checkbox"/> A-CASING	<input type="checkbox"/> SHELBY TUBE	<input type="checkbox"/> CORE
BACKFILL TYPE	<input checked="" type="checkbox"/> BENTONITE	<input type="checkbox"/> PEA GRAVEL	<input type="checkbox"/> SLOUGH	<input type="checkbox"/> GROUT	<input type="checkbox"/> DRILL CUTTINGS	<input type="checkbox"/> SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	SPT (N)	MOISTURE CONTENT	PLASTICITY INDEX		STANDARD PENETRATION (N)	UNC. COMPRESSIVE STRENGTH (kPa)	POCKET PEN. (kPa)	Depth (ft)
						PLASTIC	M.C. LIQUID				
0	GRAVEL (FILL) - sandy, silty, trace clay, subrounded, well graded, sizes to 25 mm, damp, brown CLAY (FILL) - silty, some sand, trace gravel, moist, hard, medium plastic, dark brown with dark grey mottling, oxide staining, hydrocarbon odor		B1	25.1	55	20	60	25	100	150	0
1	CLAY (TILL) - silty, some sand, trace gravel, moist, hard, medium plastic, brown, coal and oxide specks, small silt and sand pockets		D1	35	55	20	60	35	150	200	3
2	CLAY (TILL) - silty, some sand, trace gravel, moist, hard, medium plastic, brown, coal and oxide specks, small silt and sand pockets		B2	19.3	55	20	60	19	100	150	6
2	End of Borehole @ 2.0 m		D2	38	55	20	60	38	150	200	6
2	No Seepage, Minor Sloughing Upon Completion No Standpipe Installed										
3											10
4											15
5											16



LOGGED BY: SS	COMPLETION DEPTH: 2 m
REVIEWED BY: JZ	COMPLETE: 8/25/2015
DRAWING NO: B9	Page 1 of 1

PROJECT: VILLAGE OF GLENWOOD ROADWAYS	CLIENT: VILLAGE OF GLENWOOD	BOREHOLE NO: 15BH010
LOCATION: ALL INTERSECTIONS IN TOWN	DRILL METHOD: 150mm SOLID STEM AUGER	PROJECT: L12103982-01
CITY: GLENWOOD, AB	N - 5471499, E - 317939	

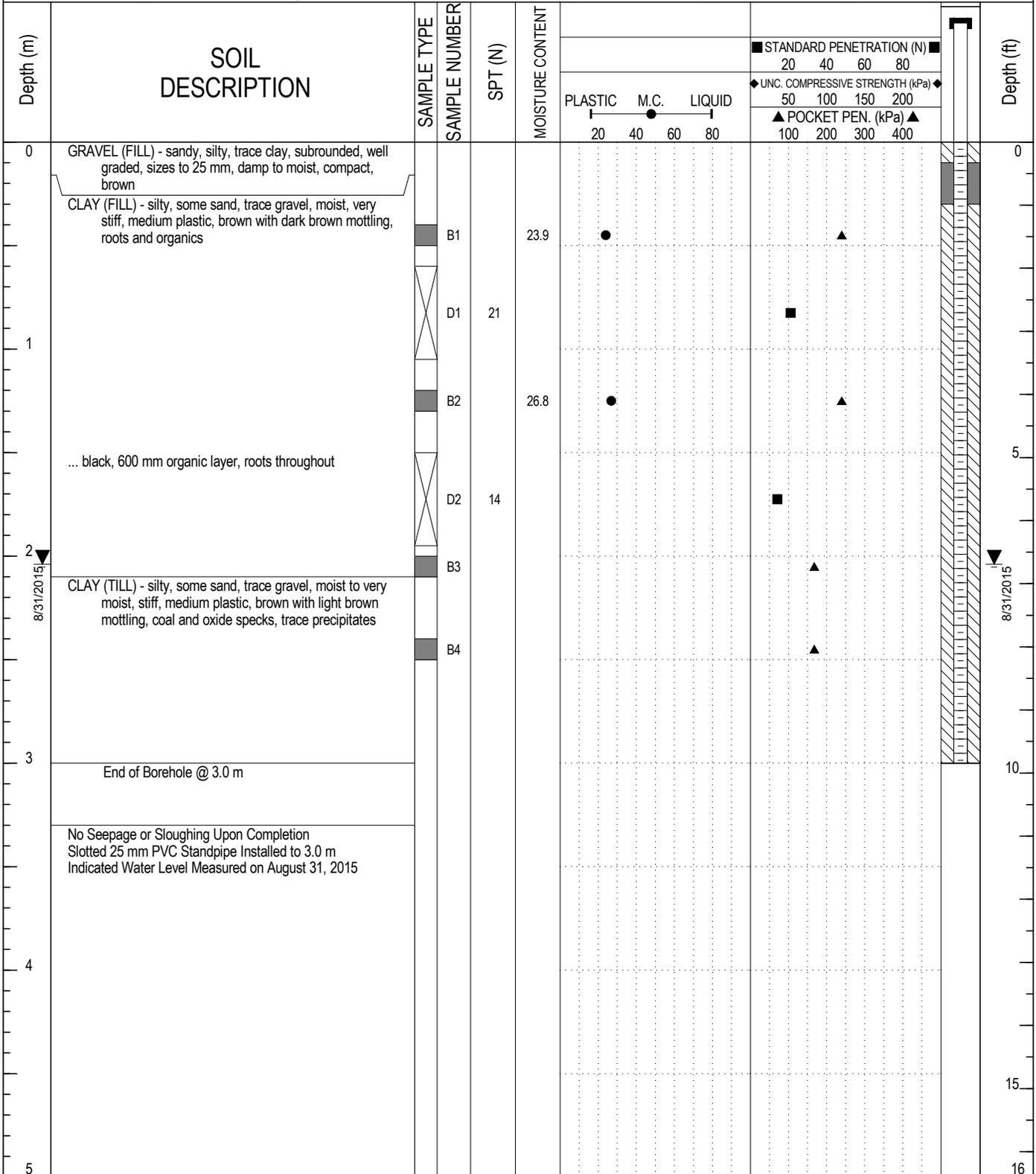
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BACKFILL TYPE	<input checked="" type="checkbox"/> BENTONITE	<input type="checkbox"/> PEA GRAVEL	<input type="checkbox"/> SLOUGH	<input type="checkbox"/> GROUT	<input type="checkbox"/> DRILL CUTTINGS	<input type="checkbox"/> SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	SPT (N)	MOISTURE CONTENT	PLASTICITY INDEX			STANDARD PENETRATION (N)	UNC. COMPRESSIVE STRENGTH (kPa)	POCKET PEN. (kPa)	Depth (ft)
						PLASTIC	M.C.	LIQUID				
0	GRAVEL (FILL) - sandy, silty, trace clay, subrounded, well graded, sizes to 25											0
	CLAY (FILL) - silty, some sand, trace gravel, moist, very stiff, medium plastic, brown, coal and oxide specks, trace organics	<input checked="" type="checkbox"/>	B1		15.8							
	CLAY (TILL) - silty, some sand, trace gravel, moist, very stiff to hard, medium plastic, brown coal and oxide specks, silt pockets to 15 mm	<input checked="" type="checkbox"/>	D1	30								
1												
		<input checked="" type="checkbox"/>	B2		14.7							
		<input checked="" type="checkbox"/>	D2	55								
2	End of Borehole @ 2.0 m											
	No Seepage, Minor Sloughing Upon Completion No Standpipe Installed											
3												
4												
5												

	LOGGED BY: SS	COMPLETION DEPTH: 2 m
	REVIEWED BY: JZ	COMPLETE: 8/25/2015
	DRAWING NO: B10	Page 1 of 1

PROJECT: VILLAGE OF GLENWOOD ROADWAYS	CLIENT: VILLAGE OF GLENWOOD	BOREHOLE NO: 15BH011
LOCATION: ALL INTERSECTIONS IN TOWN	DRILL METHOD: 150mm SOLID STEM AUGER	PROJECT: L12103982-01
CITY: GLENWOOD, AB	N - 5471300, E - 317932	

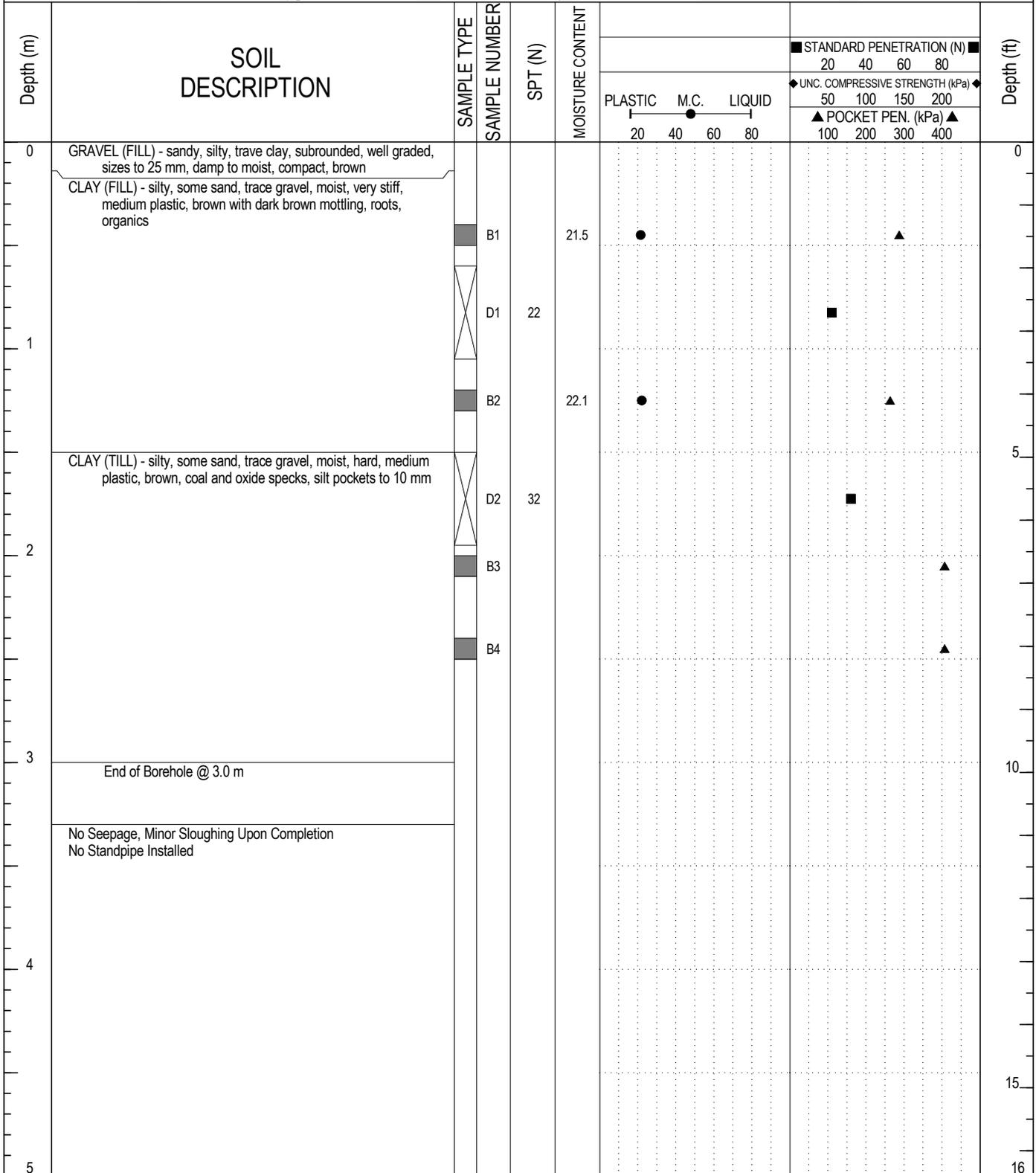
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BACKFILL TYPE	<input checked="" type="checkbox"/> BENTONITE	<input type="checkbox"/> PEA GRAVEL	<input type="checkbox"/> SLOUGH	<input type="checkbox"/> GROUT	<input type="checkbox"/> DRILL CUTTINGS	<input type="checkbox"/> SAND



	LOGGED BY: SS	COMPLETION DEPTH: 3 m
	REVIEWED BY: JZ	COMPLETE: 8/25/2015
	DRAWING NO: B11	Page 1 of 1

PROJECT: VILLAGE OF GLENWOOD ROADWAYS	CLIENT: VILLAGE OF GLENWOOD	BOREHOLE NO: 15BH012
LOCATION: ALL INTERSECTIONS IN TOWN	DRILL METHOD: 150mm SOLID STEM AUGER	PROJECT: L12103982-01
CITY: GLENWOOD, AB	N - 5471101, E - 317928	

SAMPLE TYPE	<input checked="" type="checkbox"/> DISTURBED	<input type="checkbox"/> NO RECOVERY	<input checked="" type="checkbox"/> SPT	<input type="checkbox"/> A-CASING	<input type="checkbox"/> SHELBY TUBE	<input type="checkbox"/> CORE
BACKFILL TYPE	<input checked="" type="checkbox"/> BENTONITE	<input type="checkbox"/> PEA GRAVEL	<input type="checkbox"/> SLOUGH	<input type="checkbox"/> GROUT	<input type="checkbox"/> DRILL CUTTINGS	<input type="checkbox"/> SAND



 <b>TETRA TECH EBA</b>	LOGGED BY: SS	COMPLETION DEPTH: 3 m
	REVIEWED BY: JZ	COMPLETE: 8/25/2015
	DRAWING NO: B12	Page 1 of 1

PROJECT: VILLAGE OF GLENWOOD ROADWAYS	CLIENT: VILLAGE OF GLENWOOD	BOREHOLE NO: 15BH013
LOCATION: ALL INTERSECTIONS IN TOWN	DRILL METHOD: 150mm SOLID STEM AUGER	PROJECT: L12103982-01
CITY: GLENWOOD, AB	N - 5470893, E - 317933	

SAMPLE TYPE	<input checked="" type="checkbox"/> DISTURBED	<input type="checkbox"/> NO RECOVERY	<input checked="" type="checkbox"/> SPT	<input type="checkbox"/> A-CASING	<input type="checkbox"/> SHELBY TUBE	<input type="checkbox"/> CORE
BACKFILL TYPE	<input checked="" type="checkbox"/> BENTONITE	<input type="checkbox"/> PEA GRAVEL	<input type="checkbox"/> SLOUGH	<input type="checkbox"/> GROUT	<input type="checkbox"/> DRILL CUTTINGS	<input type="checkbox"/> SAND

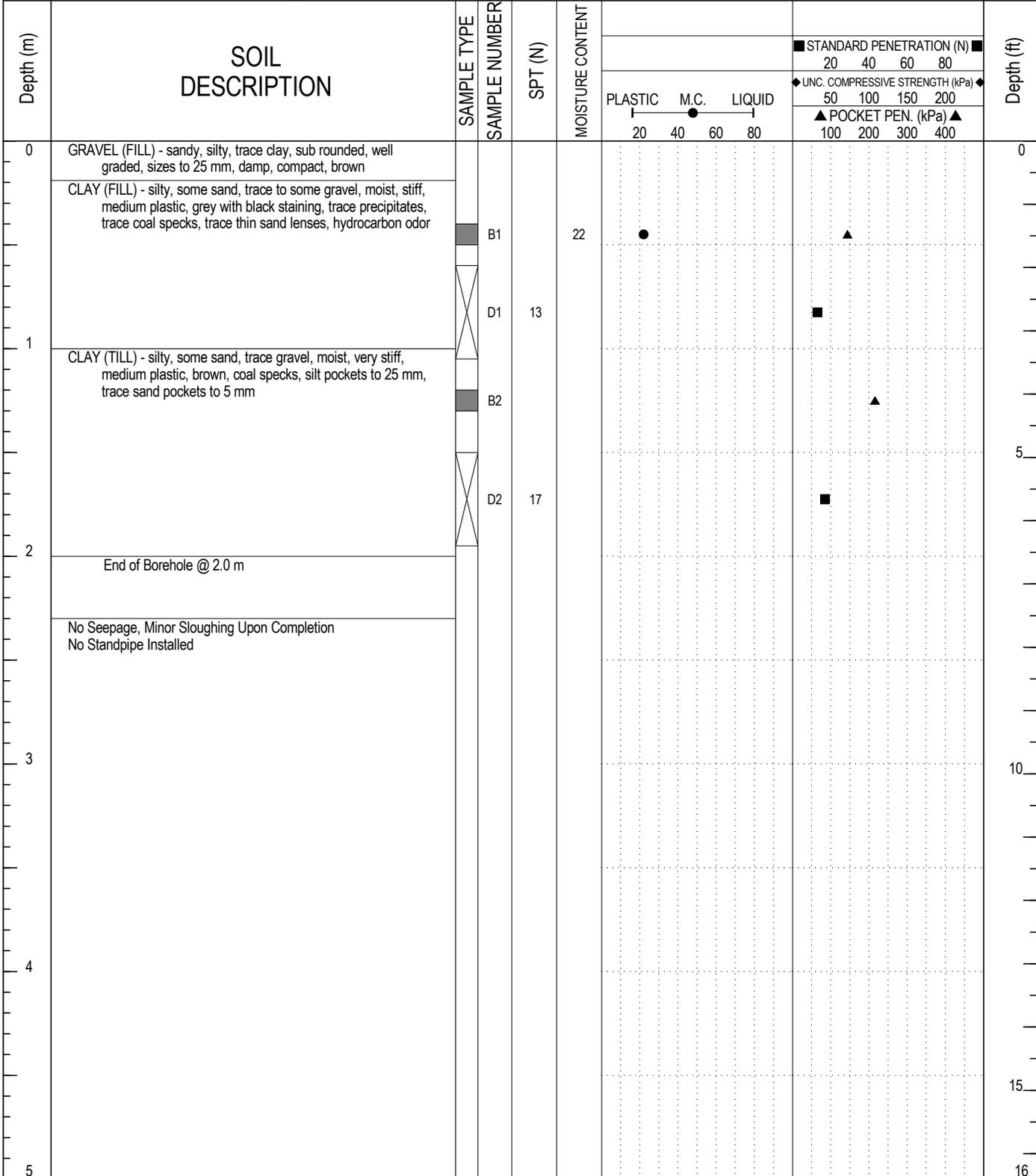
Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	SPT (N)	MOISTURE CONTENT	PLASTICITY INDEX			STANDARD PENETRATION (N)	UNC. COMPRESSIVE STRENGTH (kPa)	POCKET PEN. (kPa)	Depth (ft)
						PLASTIC	M.C.	LIQUID				
0	ASPHALT (90 mm)											0
	GRAVEL (FILL) - sandy, silty, some clay, subrounded, well graded, sizes to 25 mm, moist, compact, brown											
	CLAY (FILL) - silty, some sand, some gravel, moist, stiff, medium plastic, dark grey with black mottling, hydrocarbon odor	<input checked="" type="checkbox"/>	B1	21.2	●				▲			
1		<input checked="" type="checkbox"/>	D1	13					■			
	CLAY (TILL) - silty, some sand, trace gravel, moist, stiff, medium plastic, light brown, coal and oxide specks, small silt and sand pockets	<input checked="" type="checkbox"/>	B2	25.8	●				▲			
2		<input checked="" type="checkbox"/>	D2	14					■			
2	End of Borehole @ 2.0 m											
	No Seepage, Minor Sloughing Upon Completion No Standpipe Installed											
3												10
4												15
5												16



LOGGED BY: SS	COMPLETION DEPTH: 2 m
REVIEWED BY: JZ	COMPLETE: 8/20/2015
DRAWING NO: B13	Page 1 of 1

PROJECT: VILLAGE OF GLENWOOD ROADWAYS	CLIENT: VILLAGE OF GLENWOOD	BOREHOLE NO: 15BH014
LOCATION: ALL INTERSECTIONS IN TOWN	DRILL METHOD: 150mm SOLID STEM AUGER	PROJECT: L12103982-01
CITY: GLENWOOD, AB	N - 5470509, E - 317488	

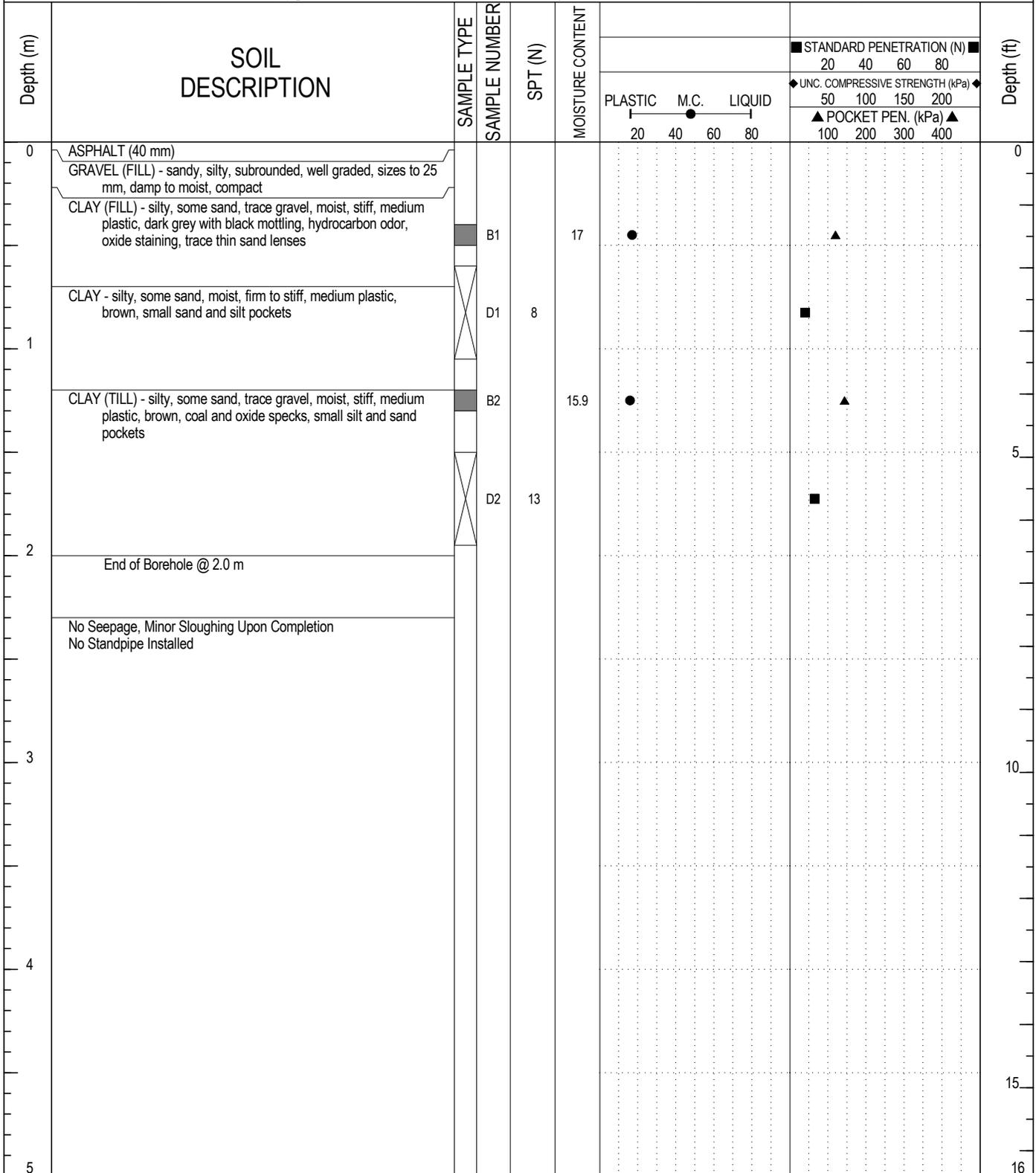
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BACKFILL TYPE	<input checked="" type="checkbox"/> BENTONITE	<input type="checkbox"/> PEA GRAVEL	<input type="checkbox"/> SLOUGH	<input type="checkbox"/> GROUT	<input type="checkbox"/> DRILL CUTTINGS	<input type="checkbox"/> SAND



 <b>TETRA TECH EBA</b>	LOGGED BY: SS	COMPLETION DEPTH: 2 m
	REVIEWED BY: JZ	COMPLETE: 8/20/2015
	DRAWING NO: B14	Page 1 of 1

PROJECT: VILLAGE OF GLENWOOD ROADWAYS	CLIENT: VILLAGE OF GLENWOOD	BOREHOLE NO: 15BH015
LOCATION: ALL INTERSECTIONS IN TOWN	DRILL METHOD: 150mm SOLID STEM AUGER	PROJECT: L12103982-01
CITY: GLENWOOD, AB	N - 5470712, E - 317485	

SAMPLE TYPE	<input checked="" type="checkbox"/> DISTURBED	<input type="checkbox"/> NO RECOVERY	<input checked="" type="checkbox"/> SPT	<input type="checkbox"/> A-CASING	<input type="checkbox"/> SHELBY TUBE	<input type="checkbox"/> CORE
BACKFILL TYPE	<input checked="" type="checkbox"/> BENTONITE	<input type="checkbox"/> PEA GRAVEL	<input type="checkbox"/> SLOUGH	<input type="checkbox"/> GROUT	<input type="checkbox"/> DRILL CUTTINGS	<input type="checkbox"/> SAND



	LOGGED BY: SS	COMPLETION DEPTH: 2 m
	REVIEWED BY: JZ	COMPLETE: 8/20/2015
	DRAWING NO: B15	Page 1 of 1

PROJECT: VILLAGE OF GLENWOOD ROADWAYS	CLIENT: VILLAGE OF GLENWOOD	BOREHOLE NO: 15BH016
LOCATION: ALL INTERSECTIONS IN TOWN	DRILL METHOD: 150mm SOLID STEM AUGER	PROJECT: L12103982-01
CITY: GLENWOOD, AB	N - 5470909, E - 317506	

SAMPLE TYPE	<input checked="" type="checkbox"/> DISTURBED	<input type="checkbox"/> NO RECOVERY	<input checked="" type="checkbox"/> SPT	<input type="checkbox"/> A-CASING	<input type="checkbox"/> SHELBY TUBE	<input type="checkbox"/> CORE
BACKFILL TYPE	<input checked="" type="checkbox"/> BENTONITE	<input type="checkbox"/> PEA GRAVEL	<input type="checkbox"/> SLOUGH	<input type="checkbox"/> GROUT	<input type="checkbox"/> DRILL CUTTINGS	<input type="checkbox"/> SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	SPT (N)	MOISTURE CONTENT	PLASTICITY INDEX			STANDARD PENETRATION (N)	UNC. COMPRESSIVE STRENGTH (kPa)	POCKET PEN. (kPa)	Depth (ft)
						PLASTIC	M.C.	LIQUID				
0	ASPHALT (80 mm) CLAY (FILL) - gravelly, silty, sandy, moist, stiff to very stiff, medium plastic, dark brownish grey with black mottling, hydrocarbon odor, trace root hairs		B1	7.6	7.6				20			0
1	... moist to very moist, blackish dark grey ... silt pockets to 25 mm		D1	15								
2	CLAY (TILL) - silty, some sand, trace gravel, moist, stiff to very stiff, medium plastic, light greyish brown, coal and oxide specks, small silt and sand pockets		B2	13.9	13.9							5
2	End of Borehole @ 2.0 m		D2	15								
3	No Seepage or Sloughing Upon Completion No Standpipe Installed											
4												
5												



LOGGED BY: SS	COMPLETION DEPTH: 2 m
REVIEWED BY: JZ	COMPLETE: 8/20/2015
DRAWING NO: B16	Page 1 of 1

PROJECT: VILLAGE OF GLENWOOD ROADWAYS	CLIENT: VILLAGE OF GLENWOOD	BOREHOLE NO: 15BH017
LOCATION: ALL INTERSECTIONS IN TOWN	DRILL METHOD: 150mm SOLID STEM AUGER	PROJECT: L12103982-01
CITY: GLENWOOD, AB	N - 5471116, E - 317510	

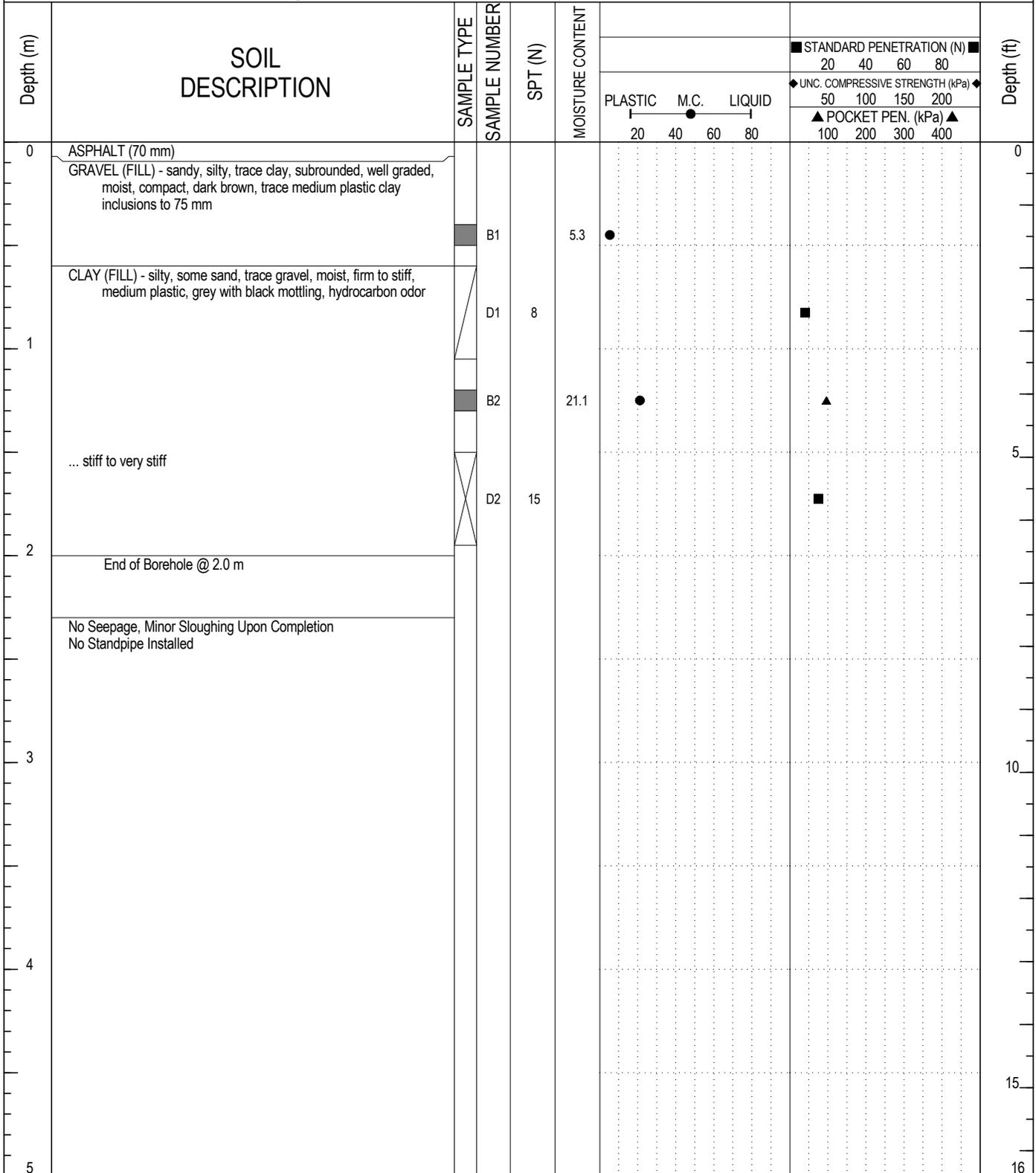
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BACKFILL TYPE	<input checked="" type="checkbox"/> BENTONITE	<input type="checkbox"/> PEA GRAVEL	<input type="checkbox"/> SLOUGH	<input type="checkbox"/> GROUT	<input type="checkbox"/> DRILL CUTTINGS	<input type="checkbox"/> SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	SPT (N)	MOISTURE CONTENT	PLASTICITY INDEX			Depth (ft)
						PLASTIC	M.C.	LIQUID	
0	ASPHALT (90 mm)								0
	GRAVEL (FILL) - sandy, silty, trace clay, subrounded, well graded, sizes to 75 mm, moist, compact, brown	<input checked="" type="checkbox"/>	B1	4.2	●				
	CLAY (FILL) - silty, some sand, trace gravel, moist, very stiff, medium plastic, dark grey with black mottling, hydrocarbon odor	<input checked="" type="checkbox"/>	D1	24				■	
1	CLAY (TILL) - silty, some sand, trace gravel, moist, very stiff, medium plastic, brown, coal and oxide specks, silt pockets to 25 mm	<input checked="" type="checkbox"/>	B2	22	●				
		<input checked="" type="checkbox"/>	D2	26				■	
2	End of Borehole @ 2.0 m								
	No Seepage, Minor Sloughing Upon Completion No Standpipe Installed								
3									10
4									15
5									16

 <b>TETRA TECH EBA</b>	LOGGED BY: SS	COMPLETION DEPTH: 2 m
	REVIEWED BY: JZ	COMPLETE: 8/25/2015
	DRAWING NO: B17	Page 1 of 1

PROJECT: VILLAGE OF GLENWOOD ROADWAYS	CLIENT: VILLAGE OF GLENWOOD	BOREHOLE NO: 15BH018
LOCATION: ALL INTERSECTIONS IN TOWN	DRILL METHOD: 150mm SOLID STEM AUGER	PROJECT: L12103982-01
CITY: GLENWOOD, AB	N - 5471310, E - 317517	

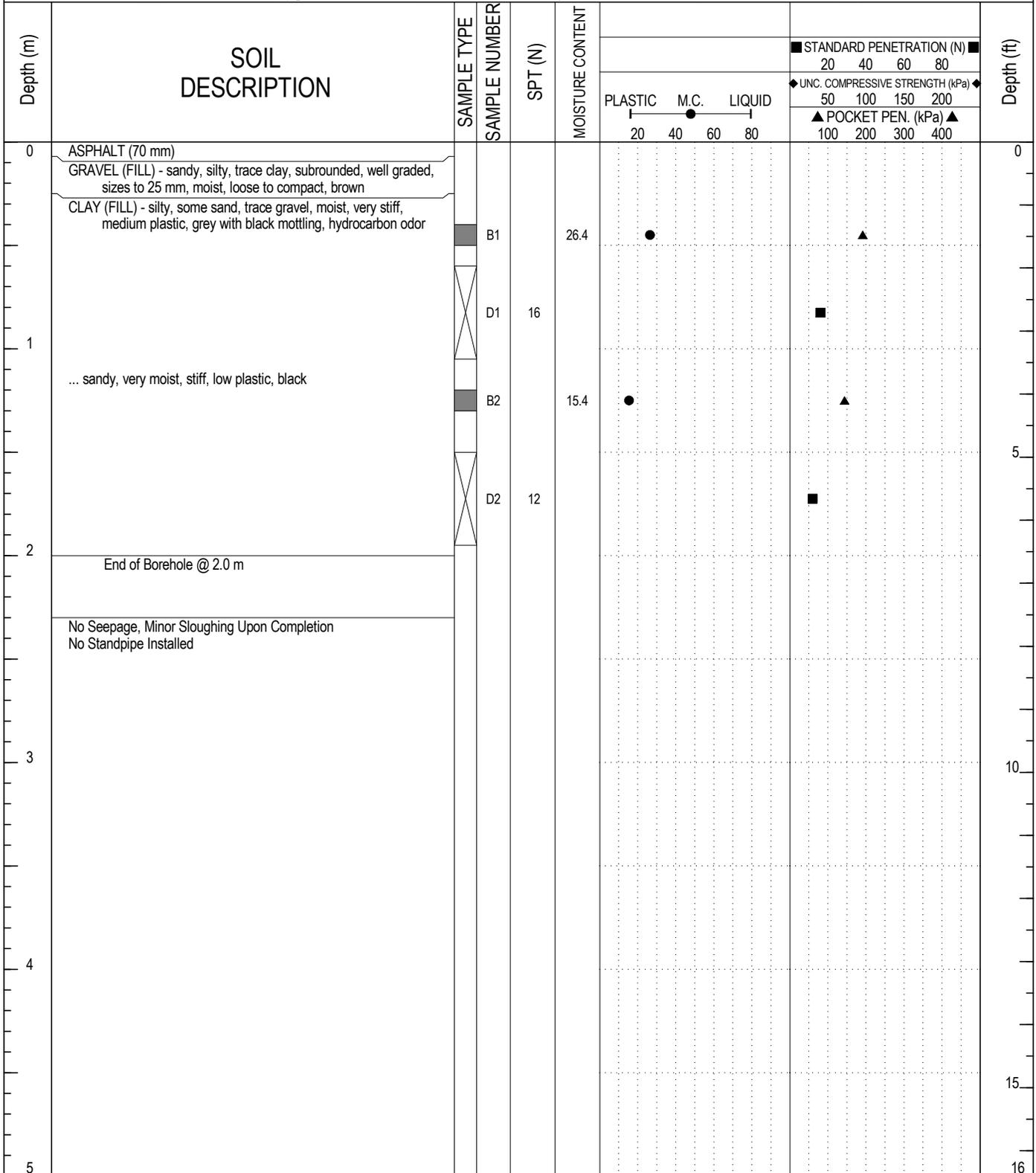
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BACKFILL TYPE	<input checked="" type="checkbox"/> BENTONITE	<input type="checkbox"/> PEA GRAVEL	<input type="checkbox"/> SLOUGH	<input type="checkbox"/> GROUT	<input type="checkbox"/> DRILL CUTTINGS	<input type="checkbox"/> SAND



LOGGED BY: SS	COMPLETION DEPTH: 2 m
REVIEWED BY: JZ	COMPLETE: 8/25/2015
DRAWING NO: B18	Page 1 of 1

PROJECT: VILLAGE OF GLENWOOD ROADWAYS	CLIENT: VILLAGE OF GLENWOOD	BOREHOLE NO: 15BH019
LOCATION: ALL INTERSECTIONS IN TOWN	DRILL METHOD: 150mm SOLID STEM AUGER	PROJECT: L12103982-01
CITY: GLENWOOD, AB	N - 5471514, E - 317520	

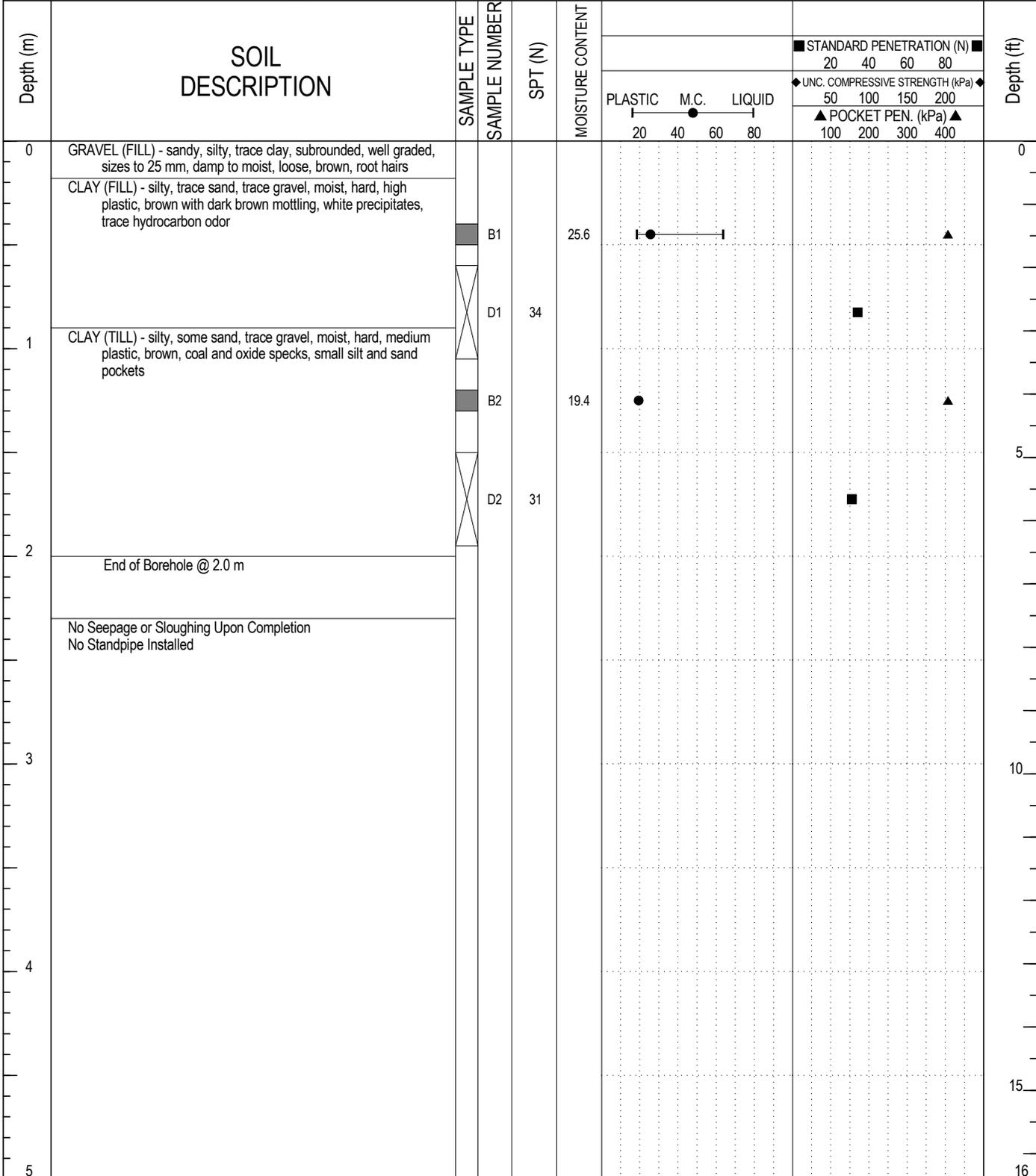
SAMPLE TYPE	<input checked="" type="checkbox"/> DISTURBED	<input type="checkbox"/> NO RECOVERY	<input checked="" type="checkbox"/> SPT	<input type="checkbox"/> A-CASING	<input type="checkbox"/> SHELBY TUBE	<input type="checkbox"/> CORE
BACKFILL TYPE	<input checked="" type="checkbox"/> BENTONITE	<input type="checkbox"/> PEA GRAVEL	<input type="checkbox"/> SLOUGH	<input type="checkbox"/> GROUT	<input type="checkbox"/> DRILL CUTTINGS	<input type="checkbox"/> SAND



LOGGED BY: SS	COMPLETION DEPTH: 2 m
REVIEWED BY: JZ	COMPLETE: 8/25/2015
DRAWING NO: B19	Page 1 of 1

PROJECT: VILLAGE OF GLENWOOD ROADWAYS	CLIENT: VILLAGE OF GLENWOOD	BOREHOLE NO: 15BH021
LOCATION: ALL INTERSECTIONS IN TOWN	DRILL METHOD: 150mm SOLID STEM AUGER	PROJECT: L12103982-01
CITY: GLENWOOD, AB	N - 5471720, E - 317331	

SAMPLE TYPE	<input checked="" type="checkbox"/> DISTURBED	<input type="checkbox"/> NO RECOVERY	<input checked="" type="checkbox"/> SPT	<input type="checkbox"/> A-CASING	<input type="checkbox"/> SHELBY TUBE	<input type="checkbox"/> CORE
BACKFILL TYPE	<input checked="" type="checkbox"/> BENTONITE	<input type="checkbox"/> PEA GRAVEL	<input type="checkbox"/> SLOUGH	<input type="checkbox"/> GROUT	<input type="checkbox"/> DRILL CUTTINGS	<input type="checkbox"/> SAND



	LOGGED BY: SS	COMPLETION DEPTH: 2 m
	REVIEWED BY: JZ	COMPLETE: 8/25/2015
	DRAWING NO: B21	Page 1 of 1

PROJECT: VILLAGE OF GLENWOOD ROADWAYS	CLIENT: VILLAGE OF GLENWOOD	BOREHOLE NO: 15BH022
LOCATION: ALL INTERSECTIONS IN TOWN	DRILL METHOD: 150mm SOLID STEM AUGER	PROJECT: L12103982-01
CITY: GLENWOOD, AB	N - 5471522, E - 317329	

SAMPLE TYPE	<input checked="" type="checkbox"/> DISTURBED	<input type="checkbox"/> NO RECOVERY	<input checked="" type="checkbox"/> SPT	<input type="checkbox"/> A-CASING	<input type="checkbox"/> SHELBY TUBE	<input type="checkbox"/> CORE
BACKFILL TYPE	<input checked="" type="checkbox"/> BENTONITE	<input type="checkbox"/> PEA GRAVEL	<input type="checkbox"/> SLOUGH	<input type="checkbox"/> GROUT	<input type="checkbox"/> DRILL CUTTINGS	<input type="checkbox"/> SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	SPT (N)	MOISTURE CONTENT	PLASTICITY INDEX			STANDARD PENETRATION (N)	UNC. COMPRESSIVE STRENGTH (kPa)	POCKET PEN. (kPa)	Depth (ft)
						PLASTIC	M.C.	LIQUID				
0	ASPHALT (90 mm)											0
	GRAVEL (FILL) - sandy, silty, trace clay, subrounded, well graded, sizes to 25 mm, moist, brown											
	CLAY (FILL) - silty, some sand, trace gravel, moist, very stiff, medium plastic, dark brown with dark grey mottling, hydrocarbon odor	<input checked="" type="checkbox"/>	B1	24.7	24.7							
	... brown, coal and oxide specks, sand pockets to 25 mm	<input type="checkbox"/>	D1	15								
1		<input checked="" type="checkbox"/>	B2	14.5	14.5							
	... firm to stiff, roots	<input type="checkbox"/>	D2	9								
2	End of Borehole @ 2.0 m											
	No Seepage, Minor Sloughing Upon Completion No Standpipe Installed											
3												10
4												15
5												16



LOGGED BY: SS	COMPLETION DEPTH: 2 m
REVIEWED BY: JZ	COMPLETE: 8/25/2015
DRAWING NO: B22	Page 1 of 1

PROJECT: VILLAGE OF GLENWOOD ROADWAYS	CLIENT: VILLAGE OF GLENWOOD	BOREHOLE NO: 15BH023
LOCATION: ALL INTERSECTIONS IN TOWN	DRILL METHOD: 150mm SOLID STEM AUGER	PROJECT: L12103982-01
CITY: GLENWOOD, AB	N - 5471310, E - 317314	

SAMPLE TYPE	<input checked="" type="checkbox"/> DISTURBED	<input type="checkbox"/> NO RECOVERY	<input checked="" type="checkbox"/> SPT	<input type="checkbox"/> A-CASING	<input type="checkbox"/> SHELBY TUBE	<input type="checkbox"/> CORE
BACKFILL TYPE	<input checked="" type="checkbox"/> BENTONITE	<input type="checkbox"/> PEA GRAVEL	<input type="checkbox"/> SLOUGH	<input type="checkbox"/> GROUT	<input type="checkbox"/> DRILL CUTTINGS	<input type="checkbox"/> SAND

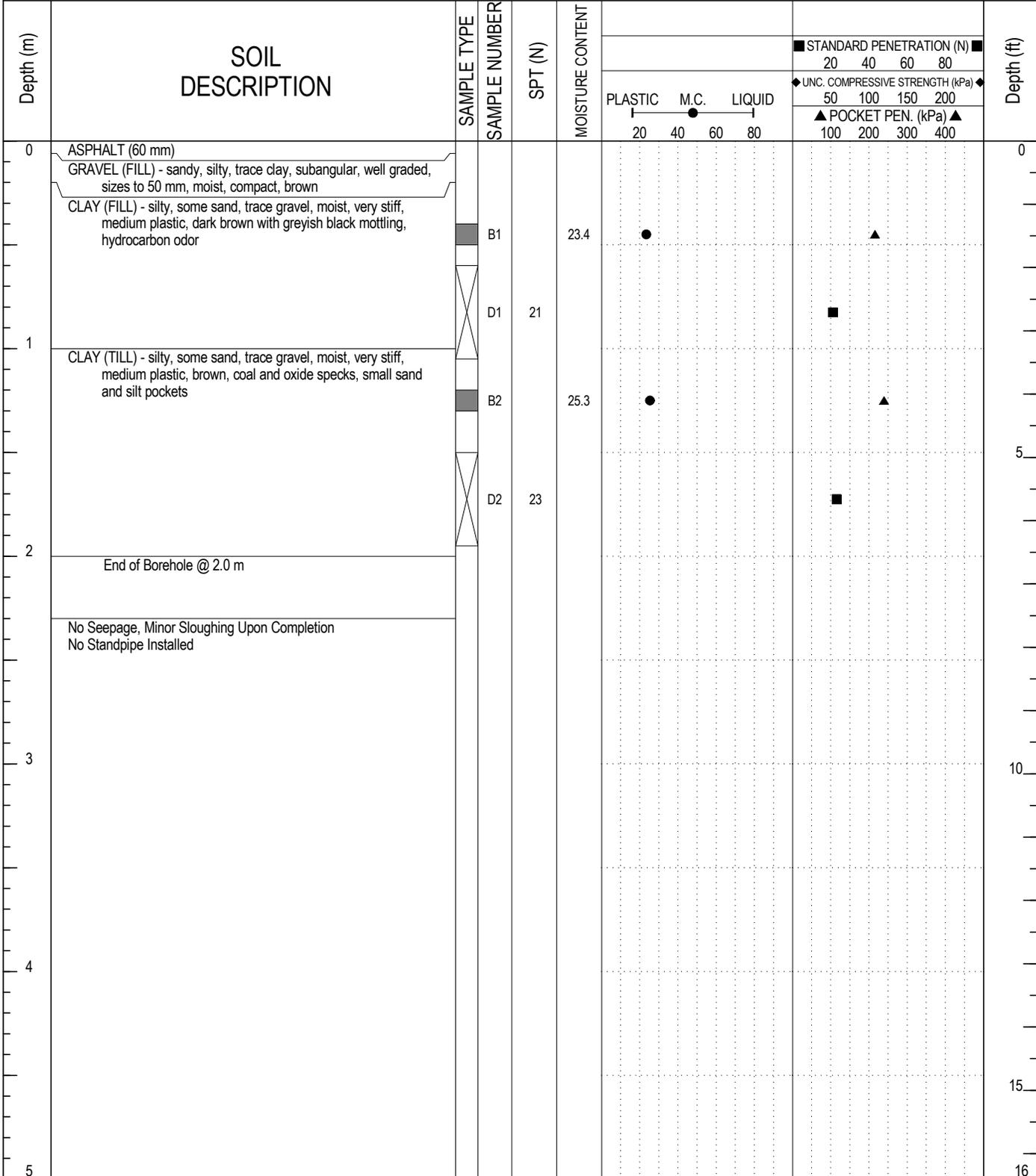
Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	SPT (N)	MOISTURE CONTENT	PLASTICITY INDEX			STANDARD PENETRATION (N)	UNC. COMPRESSIVE STRENGTH (kPa)	POCKET PEN. (kPa)	Depth (ft)
						PLASTIC	M.C.	LIQUID				
0	ASPHALT (70 mm) CLAY (FILL) - silty, some sand, gravelly, moist, very stiff, medium plastic, brown with dark brown mottling, trace hydrocarbon odor ... trace gravel	<input checked="" type="checkbox"/>	B1	17.7	17.7	20	40	60	17.7	100	100	0
1	CLAY (TILL) - silty, some sand, trace gravel, moist, stiff to very stiff, medium plastic, brown, coal and oxide specks	<input type="checkbox"/>	D1	16					16	100	100	1
2	CLAY (TILL) - silty, some sand, trace gravel, moist, stiff to very stiff, medium plastic, brown, coal and oxide specks	<input checked="" type="checkbox"/>	B2	20.3	20.3				20.3	100	100	2
2	End of Borehole @ 2.0 m	<input type="checkbox"/>	D2	16					16	100	100	2
3	No Seepage or Sloughing Upon Completion No Standpipe Installed											3
4												4
5												5



LOGGED BY: SS	COMPLETION DEPTH: 2 m
REVIEWED BY: JZ	COMPLETE: 8/25/2015
DRAWING NO: B23	Page 1 of 1

PROJECT: VILLAGE OF GLENWOOD ROADWAYS	CLIENT: VILLAGE OF GLENWOOD	BOREHOLE NO: 15BH024
LOCATION: ALL INTERSECTIONS IN TOWN	DRILL METHOD: 150mm SOLID STEM AUGER	PROJECT: L12103982-01
CITY: GLENWOOD, AB	N - 5471117, E - 317305	

SAMPLE TYPE	<input checked="" type="checkbox"/> DISTURBED	<input type="checkbox"/> NO RECOVERY	<input checked="" type="checkbox"/> SPT	<input type="checkbox"/> A-CASING	<input type="checkbox"/> SHELBY TUBE	<input type="checkbox"/> CORE
BACKFILL TYPE	<input checked="" type="checkbox"/> BENTONITE	<input type="checkbox"/> PEA GRAVEL	<input type="checkbox"/> SLOUGH	<input type="checkbox"/> GROUT	<input type="checkbox"/> DRILL CUTTINGS	<input type="checkbox"/> SAND



	LOGGED BY: SS	COMPLETION DEPTH: 2 m
	REVIEWED BY: JZ	COMPLETE: 8/25/2015
	DRAWING NO: B24	Page 1 of 1

PROJECT: VILLAGE OF GLENWOOD ROADWAYS	CLIENT: VILLAGE OF GLENWOOD	BOREHOLE NO: 15BH025
LOCATION: ALL INTERSECTIONS IN TOWN	DRILL METHOD: 150mm SOLID STEM AUGER	PROJECT: L12103982-01
CITY: GLENWOOD, AB	N - 5470918, E - 317307	

SAMPLE TYPE	<input checked="" type="checkbox"/> DISTURBED	<input type="checkbox"/> NO RECOVERY	<input checked="" type="checkbox"/> SPT	<input type="checkbox"/> A-CASING	<input type="checkbox"/> SHELBY TUBE	<input type="checkbox"/> CORE
BACKFILL TYPE	<input checked="" type="checkbox"/> BENTONITE	<input type="checkbox"/> PEA GRAVEL	<input type="checkbox"/> SLOUGH	<input type="checkbox"/> GROUT	<input type="checkbox"/> DRILL CUTTINGS	<input type="checkbox"/> SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	SPT (N)	MOISTURE CONTENT	PLASTICITY INDEX			STANDARD PENETRATION (N)	UNC. COMPRESSIVE STRENGTH (kPa)	POCKET PEN. (kPa)	Depth (ft)
						PLASTIC	M.C.	LIQUID				
0	ASPHALT (70 mm) CLAY (FILL) - gravelly, silty, sandy, moist, very stiff, low plastic, greyish dark brown with black mottling, trace hydrocarbon odor											0
		<input checked="" type="checkbox"/>	B1		10.4							
		<input checked="" type="checkbox"/>	D1	20								
		<input checked="" type="checkbox"/>	B2		19.4							
	End of Borehole @ 1.5 m											5
2	No Seepage or Sloughing Upon Completion No Standpipe Installed											
3												10
4												15
5												16



LOGGED BY: SS	COMPLETION DEPTH: 1.5 m
REVIEWED BY: JZ	COMPLETE: 8/20/2015
DRAWING NO: B25	Page 1 of 1

PROJECT: VILLAGE OF GLENWOOD ROADWAYS	CLIENT: VILLAGE OF GLENWOOD	BOREHOLE NO: 15BH026
LOCATION: ALL INTERSECTIONS IN TOWN	DRILL METHOD: 150mm SOLID STEM AUGER	PROJECT: L12103982-01
CITY: GLENWOOD, AB	N - 5470720, E - 317280	

SAMPLE TYPE	<input checked="" type="checkbox"/> DISTURBED	<input type="checkbox"/> NO RECOVERY	<input checked="" type="checkbox"/> SPT	<input type="checkbox"/> A-CASING	<input type="checkbox"/> SHELBY TUBE	<input type="checkbox"/> CORE
BACKFILL TYPE	<input checked="" type="checkbox"/> BENTONITE	<input type="checkbox"/> PEA GRAVEL	<input type="checkbox"/> SLOUGH	<input type="checkbox"/> GROUT	<input type="checkbox"/> DRILL CUTTINGS	<input type="checkbox"/> SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	SPT (N)	MOISTURE CONTENT	PLASTICITY INDEX			STANDARD PENETRATION (N)	UNC. COMPRESSIVE STRENGTH (kPa)	POCKET PEN. (kPa)	Depth (ft)
						PLASTIC	M.C.	LIQUID				
0	ASPHALT (60 mm) GRAVEL and SAND (FILL) - silty, trace clay, subrounded, well graded, damp to moist, loose to compact, brown CLAY (FILL) - silty, some sand, trace gravel, moist, stiff, medium plastic, dark brown with black mottling, hydrocarbon odor CLAY - silty, some sand, moist, stiff, medium plastic, brown ... small silt and sand pockets		B1	23.1	●				▲		0	
1	CLAY (TILL) - silty, some sand, trace gravel, moist, stiff, medium plastic, brown, coal and oxide specks, small silt and sand pockets, white precipitates ... small coal fragments		B2	15.1	●				▲		5	
2	End of Borehole @ 2.0 m											
3	No Seepage, Minor Sloughing Upon Completion No Standpipe Installed											
4												
5												



LOGGED BY: SS	COMPLETION DEPTH: 2 m
REVIEWED BY: JZ	COMPLETE: 8/20/2015
DRAWING NO: B26	Page 1 of 1

PROJECT: VILLAGE OF GLENWOOD ROADWAYS	CLIENT: VILLAGE OF GLENWOOD	BOREHOLE NO: 15BH027
LOCATION: ALL INTERSECTIONS IN TOWN	DRILL METHOD: 150mm SOLID STEM AUGER	PROJECT: L12103982-01
CITY: GLENWOOD, AB	N - 5470519, E - 317285	

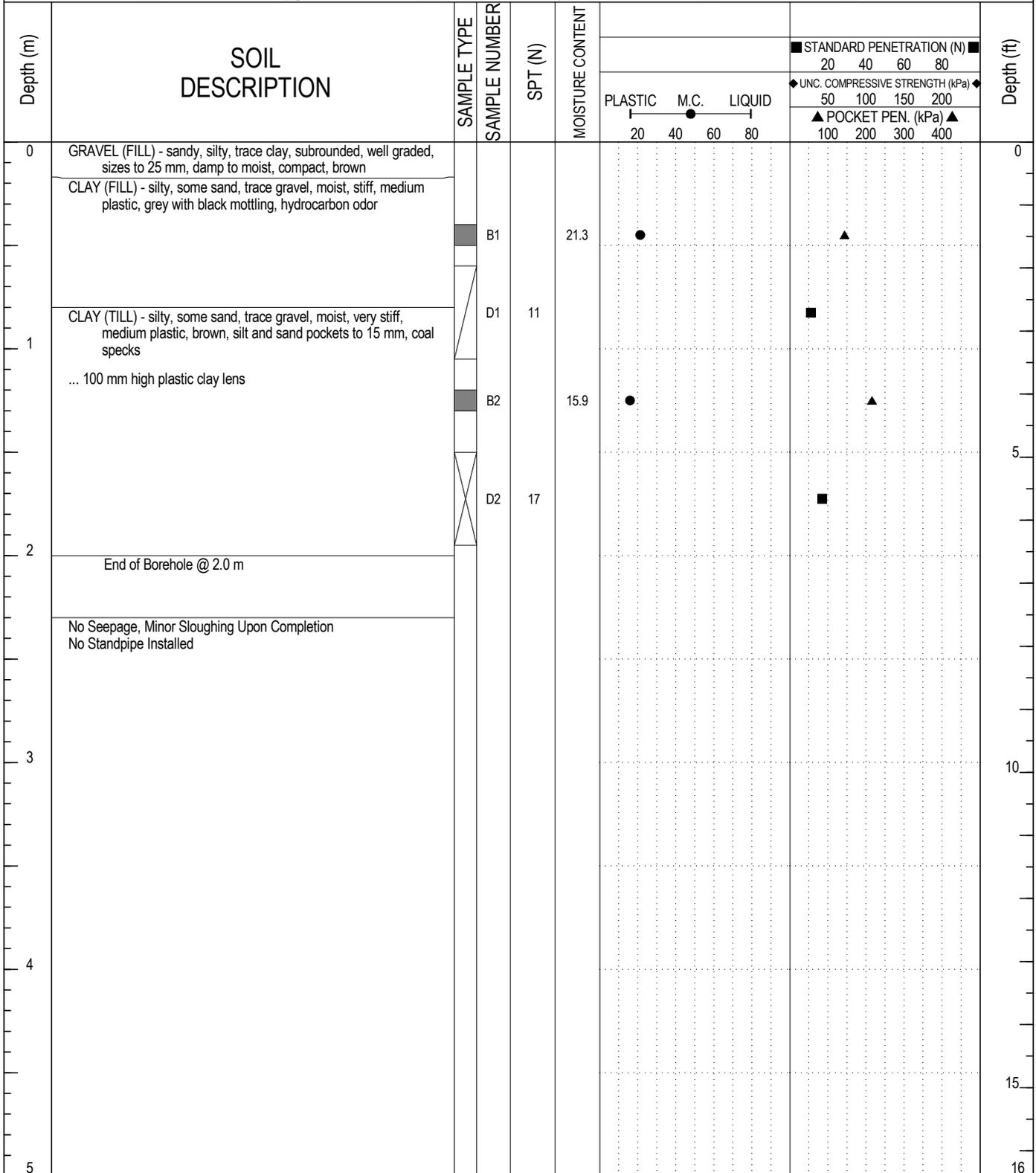
SAMPLE TYPE	<input checked="" type="checkbox"/> DISTURBED	<input type="checkbox"/> NO RECOVERY	<input checked="" type="checkbox"/> SPT	<input type="checkbox"/> A-CASING	<input type="checkbox"/> SHELBY TUBE	<input type="checkbox"/> CORE
BACKFILL TYPE	<input checked="" type="checkbox"/> BENTONITE	<input type="checkbox"/> PEA GRAVEL	<input type="checkbox"/> SLOUGH	<input type="checkbox"/> GROUT	<input type="checkbox"/> DRILL CUTTINGS	<input type="checkbox"/> SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	SPT (N)	MOISTURE CONTENT	PLASTICITY INDEX			Depth (ft)
						PLASTIC	M.C.	LIQUID	
0	GRAVEL (FILL) - sandy, silty, trace clay, sub rounded, well graded, sizes to 25 mm, moist, compact, brown								0
	CLAY (FILL) - silty, trace to some sand, trace gravel, moist, stiff, medium to high plastic, dark grey with black mottling, hydrocarbon odor, high plastic inclusions to 60 mm	<input checked="" type="checkbox"/>	B1	24.2	●			▲	
	CLAY (TILL) - silty, some sand, trace gravel, moist, very stiff, medium plastic, brown, coal and oxide specks, sand lenses to 5 mm, trace high plastic clay inclusions, trace silt pockets ... 100 mm high plastic clay pocket	<input checked="" type="checkbox"/>	D1	16				■	
		<input checked="" type="checkbox"/>	B2	17.1	●			▲	
		<input checked="" type="checkbox"/>	D2	26				■	
2	End of Borehole @ 2.0 m								
	No Seepage, Minor Sloughing Upon Completion No Standpipe Installed								
3									
4									
5									
									16

 <b>TETRA TECH EBA</b>	LOGGED BY: SS	COMPLETION DEPTH: 2 m
	REVIEWED BY: JZ	COMPLETE: 8/20/2015
	DRAWING NO: B27	Page 1 of 1

PROJECT: VILLAGE OF GLENWOOD ROADWAYS	CLIENT: VILLAGE OF GLENWOOD	BOREHOLE NO: 15BH028
LOCATION: ALL INTERSECTIONS IN TOWN	DRILL METHOD: 150mm SOLID STEM AUGER	PROJECT: L12103982-01
CITY: GLENWOOD, AB	N - 5470524, E - 317080	

SAMPLE TYPE	<input checked="" type="checkbox"/> DISTURBED	<input type="checkbox"/> NO RECOVERY	<input checked="" type="checkbox"/> SPT	<input type="checkbox"/> A-CASING	<input type="checkbox"/> SHELBY TUBE	<input type="checkbox"/> CORE
BACKFILL TYPE	<input checked="" type="checkbox"/> BENTONITE	<input type="checkbox"/> PEA GRAVEL	<input type="checkbox"/> SLOUGH	<input type="checkbox"/> GROUT	<input type="checkbox"/> DRILL CUTTINGS	<input type="checkbox"/> SAND



 <b>TETRA TECH EBA</b>	LOGGED BY: SS	COMPLETION DEPTH: 2 m
	REVIEWED BY: JZ	COMPLETE: 8/20/2015
	DRAWING NO: B28	Page 1 of 1

PROJECT: VILLAGE OF GLENWOOD ROADWAYS	CLIENT: VILLAGE OF GLENWOOD	BOREHOLE NO: 15BH029
LOCATION: ALL INTERSECTIONS IN TOWN	DRILL METHOD: 150mm SOLID STEM AUGER	PROJECT: L12103982-01
CITY: GLENWOOD, AB	N - 5470718, E - 317092	

SAMPLE TYPE	<input checked="" type="checkbox"/> DISTURBED	<input type="checkbox"/> NO RECOVERY	<input checked="" type="checkbox"/> SPT	<input type="checkbox"/> A-CASING	<input type="checkbox"/> SHELBY TUBE	<input type="checkbox"/> CORE
BACKFILL TYPE	<input checked="" type="checkbox"/> BENTONITE	<input type="checkbox"/> PEA GRAVEL	<input type="checkbox"/> SLOUGH	<input type="checkbox"/> GROUT	<input type="checkbox"/> DRILL CUTTINGS	<input type="checkbox"/> SAND

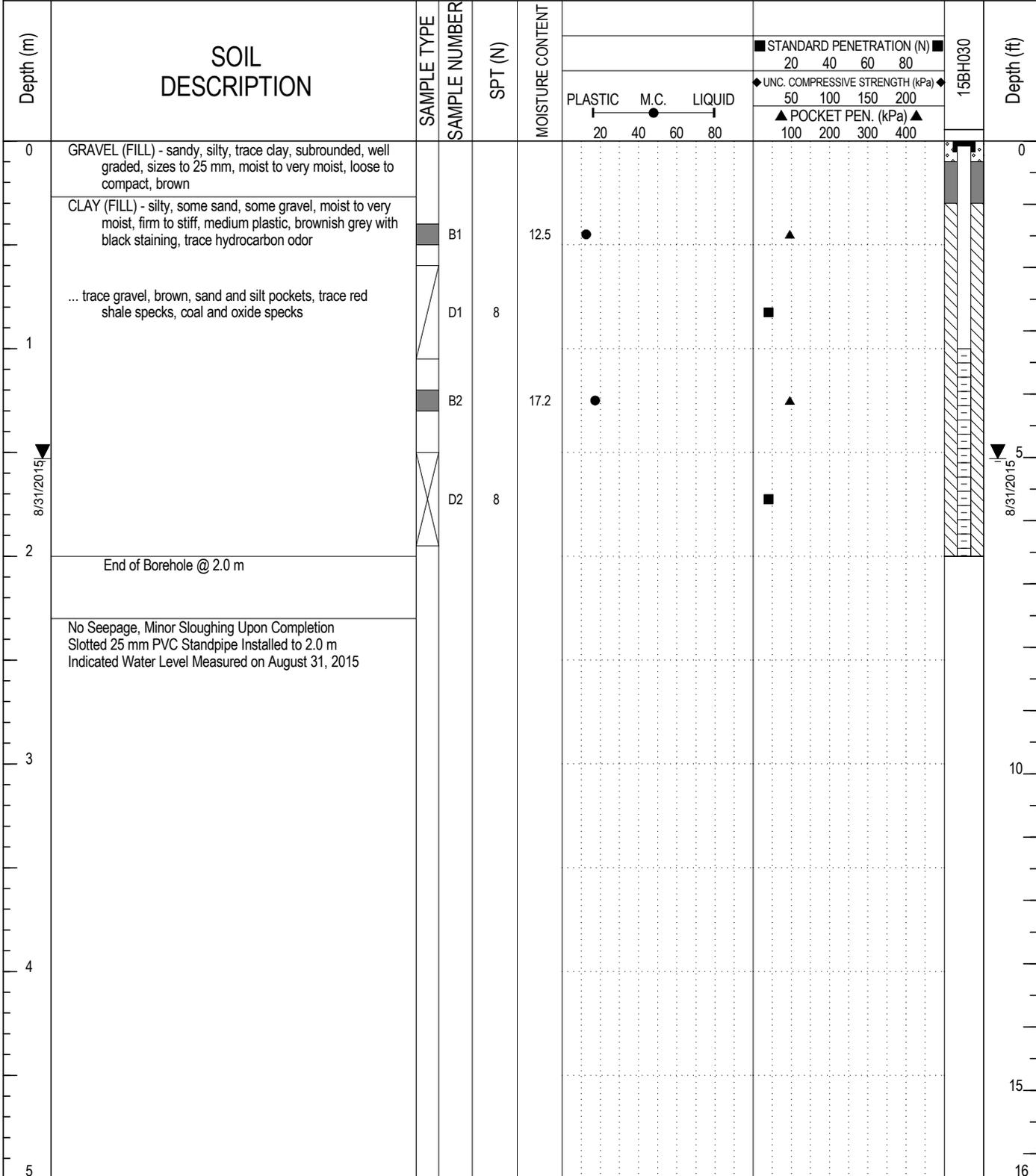
Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	SPT (N)	MOISTURE CONTENT	PLASTICITY INDEX			STANDARD PENETRATION (N)	UNC. COMPRESSIVE STRENGTH (kPa)	POCKET PEN. (kPa)	Depth (ft)
						PLASTIC	M.C.	LIQUID				
0	GRAVEL (FILL) - sandy, silty, trace clay, subrounded, well graded, sizes to 25 mm, damp to moist, brown											0
	CLAY (FILL) - silty, some sand, trace gravel, moist, firm to stiff, medium plastic, dark brown with dark brown mottling, hydrocarbon odor, oxide staining	<input checked="" type="checkbox"/>	B1	23.4	●				▲			
		<input type="checkbox"/>	D1	9					■			
1	CLAY (TILL) - silty, some sand, trace gravel, moist, stiff, medium plastic, brown, coal and oxide specks, silt and sand pockets to 25 mm	<input checked="" type="checkbox"/>	B2	20.5	●				▲			
		<input type="checkbox"/>	D2	14					■			
2	End of Borehole @ 2.0 m											
	No Seepage, Minor Sloughing Upon Completion No Standpipe Installed											
3												10
4												15
5												16



LOGGED BY: SS	COMPLETION DEPTH: 2 m
REVIEWED BY: JZ	COMPLETE: 8/20/2015
DRAWING NO: B29	Page 1 of 1

PROJECT: VILLAGE OF GLENWOOD ROADWAYS	CLIENT: VILLAGE OF GLENWOOD	BOREHOLE NO: 15BH030
LOCATION: ALL INTERSECTIONS IN TOWN	DRILL METHOD: 150mm SOLID STEM AUGER	PROJECT: L12103982-01
CITY: GLENWOOD, AB	N - 5470922, E - 317098	

SAMPLE TYPE	<input checked="" type="checkbox"/> DISTURBED	<input type="checkbox"/> NO RECOVERY	<input checked="" type="checkbox"/> SPT	<input type="checkbox"/> A-CASING	<input type="checkbox"/> SHELBY TUBE	<input type="checkbox"/> CORE
BACKFILL TYPE	<input type="checkbox"/> BENTONITE	<input type="checkbox"/> PEA GRAVEL	<input type="checkbox"/> SLOUGH	<input type="checkbox"/> GROUT	<input type="checkbox"/> DRILL CUTTINGS	<input type="checkbox"/> SAND



	LOGGED BY: SS	COMPLETION DEPTH: 2 m
	REVIEWED BY: JZ	COMPLETE: 8/20/2015
	DRAWING NO: B30	Page 1 of 1

PROJECT: VILLAGE OF GLENWOOD ROADWAYS	CLIENT: VILLAGE OF GLENWOOD	BOREHOLE NO: 15BH031
LOCATION: ALL INTERSECTIONS IN TOWN	DRILL METHOD: 150mm SOLID STEM AUGER	PROJECT: L12103982-01
CITY: GLENWOOD, AB	N - 5471121, E - 317105	

SAMPLE TYPE	<input checked="" type="checkbox"/> DISTURBED	<input type="checkbox"/> NO RECOVERY	<input checked="" type="checkbox"/> SPT	<input type="checkbox"/> A-CASING	<input type="checkbox"/> SHELBY TUBE	<input type="checkbox"/> CORE
BACKFILL TYPE	<input checked="" type="checkbox"/> BENTONITE	<input type="checkbox"/> PEA GRAVEL	<input type="checkbox"/> SLOUGH	<input type="checkbox"/> GROUT	<input type="checkbox"/> DRILL CUTTINGS	<input type="checkbox"/> SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	SPT (N)	MOISTURE CONTENT	PLASTICITY INDEX			STANDARD PENETRATION (N)	UNC. COMPRESSIVE STRENGTH (kPa)	POCKET PEN. (kPa)	Depth (ft)
						PLASTIC	M.C.	LIQUID				
0	ASPHALT (35 mm) GRAVEL and SAND (FILL) - silty, trace clay, subrounded, well graded, sizes to 25 mm, moist, loose to compact, brown CLAY (FILL) - silty, some sand, trace gravel, moist, very stiff, medium plastic, grey with black mottling, hydrocarbon odor		B1	16.7								0
	... oxide staining		D1	26								
1	CLAY - silty, some sand, moist, very stiff to hard, medium plastic, brown		B2	21.1								
	CLAY (TILL) - silty, some sand, trace gravel, moist, very stiff, medium plastic, brown, coal and oxide specks		D2	30								5
2	End of Borehole @ 2.0 m											
	No Seepage, Minor Sloughing Upon Completion No Standpipe Installed											
3												10
4												15
5												16



LOGGED BY: SS	COMPLETION DEPTH: 2 m
REVIEWED BY: JZ	COMPLETE: 8/25/2015
DRAWING NO: B31	Page 1 of 1

PROJECT: VILLAGE OF GLENWOOD ROADWAYS	CLIENT: VILLAGE OF GLENWOOD	BOREHOLE NO: 15BH032
LOCATION: ALL INTERSECTIONS IN TOWN	DRILL METHOD: 150mm SOLID STEM AUGER	PROJECT: L12103982-01
CITY: GLENWOOD, AB	N - 5471321, E - 317116	

SAMPLE TYPE	<input checked="" type="checkbox"/> DISTURBED	<input type="checkbox"/> NO RECOVERY	<input checked="" type="checkbox"/> SPT	<input type="checkbox"/> A-CASING	<input type="checkbox"/> SHELBY TUBE	<input type="checkbox"/> CORE
BACKFILL TYPE	<input checked="" type="checkbox"/> BENTONITE	<input type="checkbox"/> PEA GRAVEL	<input type="checkbox"/> SLOUGH	<input type="checkbox"/> GROUT	<input type="checkbox"/> DRILL CUTTINGS	<input type="checkbox"/> SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	SPT (N)	MOISTURE CONTENT	PLASTICITY INDEX			STANDARD PENETRATION (N)	UNC. COMPRESSIVE STRENGTH (kPa)	POCKET PEN. (kPa)	Depth (ft)
						PLASTIC	M.C.	LIQUID				
0	ASPHALT (70 mm) GRAVEL (FILL) - sandy, silty, some clay, subrounded, well graded, sizes to 25 mm, moist, compact, brown CLAY (FILL) - silty, some sand, some gravel, moist, stiff, medium plastic, grey with dark greyish black mottling, hydrocarbon odor		B1	14.7	●				▲		0	
1			D1	12					■			
			B2	16	●				▲			
2	CLAY (TILL) - silty, some sand, trace gravel, moist, very stiff, medium plastic, brown, coal and oxide specks, small sand and silt pockets		D2	22					■		5	
	End of Borehole @ 2.0 m											
	No Seepage, Minor Sloughing Upon Completion No Standpipe Installed											
3											10	
4											15	
5											16	



LOGGED BY: SS	COMPLETION DEPTH: 2 m
REVIEWED BY: JZ	COMPLETE: 8/25/2015
DRAWING NO: B32	Page 1 of 1

PROJECT: VILLAGE OF GLENWOOD ROADWAYS	CLIENT: VILLAGE OF GLENWOOD	BOREHOLE NO: 15BH033
LOCATION: ALL INTERSECTIONS IN TOWN	DRILL METHOD: 150mm SOLID STEM AUGER	PROJECT: L12103982-01
CITY: GLENWOOD, AB	N - 5471535, E - 317117	

SAMPLE TYPE	<input checked="" type="checkbox"/> DISTURBED	<input type="checkbox"/> NO RECOVERY	<input checked="" type="checkbox"/> SPT	<input type="checkbox"/> A-CASING	<input type="checkbox"/> SHELBY TUBE	<input type="checkbox"/> CORE
BACKFILL TYPE	<input checked="" type="checkbox"/> BENTONITE	<input type="checkbox"/> PEA GRAVEL	<input type="checkbox"/> SLOUGH	<input type="checkbox"/> GROUT	<input type="checkbox"/> DRILL CUTTINGS	<input type="checkbox"/> SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	SPT (N)	MOISTURE CONTENT	PLASTICITY INDEX			STANDARD PENETRATION (N)	UNC. COMPRESSIVE STRENGTH (kPa)	POCKET PEN. (kPa)	Depth (ft)
						PLASTIC	M.C.	LIQUID				
0	ASPHALT (30 mm) CLAY (FILL) - silty, some sand, some gravel, moist, stiff, to very stiff, medium plastic, brown with dark grey mottling, sand pockets to 25 mm, hydrocarbon odor		B1	17								0
1			D1	15								
	CLAY (FILL) - silty, some sand, trace gravel, moist, very stiff, medium plastic, brown, coal and oxide specks, small silt and sand pockets		B2	16.9								
2			D2	25								
	End of Borehole @ 2.0 m											
	No Seepage or Sloughing Upon Completion No Standpipe Installed											
3												
4												
5												

 <b>TETRA TECH EBA</b>	LOGGED BY: SS	COMPLETION DEPTH: 2 m
	REVIEWED BY: JZ	COMPLETE: 8/25/2015
	DRAWING NO: B33	Page 1 of 1

PROJECT: VILLAGE OF GLENWOOD ROADWAYS	CLIENT: VILLAGE OF GLENWOOD	BOREHOLE NO: 15BH034
LOCATION: ALL INTERSECTIONS IN TOWN	DRILL METHOD: 150mm SOLID STEM AUGER	PROJECT: L12103982-01
CITY: GLENWOOD, AB	N - 5471729, E - 317116	

SAMPLE TYPE	<input checked="" type="checkbox"/> DISTURBED	<input type="checkbox"/> NO RECOVERY	<input checked="" type="checkbox"/> SPT	<input type="checkbox"/> A-CASING	<input type="checkbox"/> SHELBY TUBE	<input type="checkbox"/> CORE
BACKFILL TYPE	<input checked="" type="checkbox"/> BENTONITE	<input type="checkbox"/> PEA GRAVEL	<input type="checkbox"/> SLOUGH	<input type="checkbox"/> GROUT	<input type="checkbox"/> DRILL CUTTINGS	<input type="checkbox"/> SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	SPT (N)	MOISTURE CONTENT	PLASTICITY INDEX			Depth (ft)
						PLASTIC	M.C.	LIQUID	
0	ASPHALT (40 mm) CLAY (FILL) - silty, gravelly, some sand, moist, very stiff, low plastic, dark grey with black mottling, hydrocarbon odor ... trace gravel, coal specks		B1	23.7	●			▲	0
1	CLAY (TILL) - silty, some sand, trace gravel, moist, very stiff, medium plastic, brown, coal and oxide specks, small silt and sand pockets		B2	28.1	●			▲	5
2	End of Borehole @ 2.0 m		D1	17				■	
	No Seepage or Sloughing Upon Completion No Standpipe Installed		D2	24				■	
3									10
4									15
5									16



LOGGED BY: SS	COMPLETION DEPTH: 2 m
REVIEWED BY: JZ	COMPLETE: 8/25/2015
DRAWING NO: B34	Page 1 of 1

PROJECT: VILLAGE OF GLENWOOD ROADWAYS	CLIENT: VILLAGE OF GLENWOOD	BOREHOLE NO: 15BH035
LOCATION: ALL INTERSECTIONS IN TOWN	DRILL METHOD: 150mm SOLID STEM AUGER	PROJECT: L12103982-01
CITY: GLENWOOD, AB	N - 5471740, E - 316926	

SAMPLE TYPE	<input checked="" type="checkbox"/> DISTURBED	<input type="checkbox"/> NO RECOVERY	<input checked="" type="checkbox"/> SPT	<input type="checkbox"/> A-CASING	<input type="checkbox"/> SHELBY TUBE	<input type="checkbox"/> CORE
BACKFILL TYPE	<input checked="" type="checkbox"/> BENTONITE	<input type="checkbox"/> PEA GRAVEL	<input type="checkbox"/> SLOUGH	<input type="checkbox"/> GROUT	<input type="checkbox"/> DRILL CUTTINGS	<input type="checkbox"/> SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	SPT (N)	MOISTURE CONTENT	PLASTICITY INDEX			STANDARD PENETRATION (N)	UNC. COMPRESSIVE STRENGTH (kPa)	POCKET PEN. (kPa)	Depth (ft)
						PLASTIC	M.C.	LIQUID				
0	GRAVEL (FILL) - sandy, silty, trace clay, subrounded, well graded, sizes to 25 mm, damp, compact, brown											0
	CLAY (FILL) - silty, some sand, trace gravel, moist, very stiff, medium plastic, black with grey mottling, hydrocarbon odor, trace small sand pockets	<input checked="" type="checkbox"/>	B1	24.4	●							
1	... grey with light grey mottling, root hairs	<input type="checkbox"/>	D1	25					■			
	CLAY (TILL) - silty, some sand, trace gravel, moist, very stiff, medium plastic, brown, coal and oxide specks, small silt and sand pockets	<input checked="" type="checkbox"/>	B2	24.7	●							
2	... trace high plastic clay inclusions	<input type="checkbox"/>	D2	24					■			
	End of Borehole @ 2.0 m											
	No Seepage, Minor Sloughing Upon Completion No Standpipe Installed											
3												10
4												15
5												16



LOGGED BY: SS	COMPLETION DEPTH: 2 m
REVIEWED BY: JZ	COMPLETE: 8/25/2015
DRAWING NO: B35	Page 1 of 1

PROJECT: VILLAGE OF GLENWOOD ROADWAYS	CLIENT: VILLAGE OF GLENWOOD	BOREHOLE NO: 15BH036
LOCATION: ALL INTERSECTIONS IN TOWN	DRILL METHOD: 150mm SOLID STEM AUGER	PROJECT: L12103982-01
CITY: GLENWOOD, AB	N - 5471539, E - 316917	

SAMPLE TYPE	<input checked="" type="checkbox"/> DISTURBED	<input type="checkbox"/> NO RECOVERY	<input checked="" type="checkbox"/> SPT	<input type="checkbox"/> A-CASING	<input type="checkbox"/> SHELBY TUBE	<input type="checkbox"/> CORE
BACKFILL TYPE	<input checked="" type="checkbox"/> BENTONITE	<input type="checkbox"/> PEA GRAVEL	<input type="checkbox"/> SLOUGH	<input type="checkbox"/> GROUT	<input type="checkbox"/> DRILL CUTTINGS	<input type="checkbox"/> SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	SPT (N)	MOISTURE CONTENT	PLASTICITY INDEX			STANDARD PENETRATION (N)	UNC. COMPRESSIVE STRENGTH (kPa)	POCKET PEN. (kPa)	Depth (ft)
						PLASTIC	M.C.	LIQUID				
0	ASPHALT (60 mm) CLAY (FILL) - silty, some sand, trace gravel, moist, very stiff, medium plastic, brown with blackish dark grey mottling, trace hydrocarbon odor, trace silt pockets	<input checked="" type="checkbox"/>	B1	24.6	●				20		▲	0
1	CLAY (TILL) - silty, some sand, trace gravel, moist, hard, medium plastic, brown, coal and oxide specks, small silt and sand pockets	<input checked="" type="checkbox"/>	B2	17.8	●				20		▲	5
2	End of Borehole @ 2.0 m											
3	No Seepage or Sloughing Upon Completion No Standpipe Installed											
4												
5												

	LOGGED BY: SS	COMPLETION DEPTH: 2 m
	REVIEWED BY: JZ	COMPLETE: 8/25/2015
	DRAWING NO: B36	Page 1 of 1

PROJECT: VILLAGE OF GLENWOOD ROADWAYS	CLIENT: VILLAGE OF GLENWOOD	BOREHOLE NO: 15BH037
LOCATION: ALL INTERSECTIONS IN TOWN	DRILL METHOD: 150mm SOLID STEM AUGER	PROJECT: L12103982-01
CITY: GLENWOOD, AB	N - 5471331, E - 316912	

SAMPLE TYPE	<input checked="" type="checkbox"/> DISTURBED	<input type="checkbox"/> NO RECOVERY	<input checked="" type="checkbox"/> SPT	<input type="checkbox"/> A-CASING	<input type="checkbox"/> SHELBY TUBE	<input type="checkbox"/> CORE
BACKFILL TYPE	<input checked="" type="checkbox"/> BENTONITE	<input type="checkbox"/> PEA GRAVEL	<input type="checkbox"/> SLOUGH	<input type="checkbox"/> GROUT	<input type="checkbox"/> DRILL CUTTINGS	<input type="checkbox"/> SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	SPT (N)	MOISTURE CONTENT	PLASTICITY INDEX			STANDARD PENETRATION (N)	UNC. COMPRESSIVE STRENGTH (kPa)	POCKET PEN. (kPa)	Depth (ft)
						PLASTIC	M.C.	LIQUID				
0	ASPHALT (60 mm)											0
	GRAVEL (FILL) - sandy, silty, trace clay, subrounded, well graded, sizes to 25 mm, moist, compact, brown											
	CLAY (FILL) - silty, some sand, trace gravel, moist, firm to stiff, medium plastic, brown with grey mottling, coal and oxide specks, small silt pockets	<input checked="" type="checkbox"/>	B1	19.8	●				▲			
	... black, hydrocarbon odor	<input type="checkbox"/>	D1	9					■			
1	... 50 mm gravel layer, sub angular, well graded, sizes to 25 mm	<input checked="" type="checkbox"/>	B2	18.7	●				▲			
	CLAY (TILL) - silty, some sand, trace gravel, moist to very moist, stiff, medium plastic, brown, coal and oxide specks	<input type="checkbox"/>	D2	10					■			5
2	End of Borehole @ 2.0 m											
	No Seepage, Minor Sloughing Upon Completion No Standpipe Installed											
3												10
4												15
5												16



LOGGED BY: SS	COMPLETION DEPTH: 2 m
REVIEWED BY: JZ	COMPLETE: 8/25/2015
DRAWING NO: B37	Page 1 of 1

PROJECT: VILLAGE OF GLENWOOD ROADWAYS	CLIENT: VILLAGE OF GLENWOOD	BOREHOLE NO: 15BH038
LOCATION: ALL INTERSECTIONS IN TOWN	DRILL METHOD: 150mm SOLID STEM AUGER	PROJECT: L12103982-01
CITY: GLENWOOD, AB	N - 5471128, E - 316905	

SAMPLE TYPE	<input checked="" type="checkbox"/> DISTURBED	<input type="checkbox"/> NO RECOVERY	<input checked="" type="checkbox"/> SPT	<input type="checkbox"/> A-CASING	<input type="checkbox"/> SHELBY TUBE	<input type="checkbox"/> CORE
BACKFILL TYPE	<input checked="" type="checkbox"/> BENTONITE	<input type="checkbox"/> PEA GRAVEL	<input type="checkbox"/> SLOUGH	<input type="checkbox"/> GROUT	<input type="checkbox"/> DRILL CUTTINGS	<input type="checkbox"/> SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	SPT (N)	MOISTURE CONTENT	PLASTICITY INDEX			STANDARD PENETRATION (N)	UNC. COMPRESSIVE STRENGTH (kPa)	POCKET PEN. (kPa)	Depth (ft)
						PLASTIC	M.C.	LIQUID				
0	ASPHALT (60 mm) GRAVEL (FILL) - sandy, silty, trace clay, subrounded, well graded, sizes to 25 mm, damp to moist, compact, brown											0
	CLAY (FILL) - sandy, silty, trace gravel, moist, stiff to very stiff, medium plastic, black with dark grey mottling, hydrocarbon odor	<input checked="" type="checkbox"/>	B1	23.8	●						▲	
	CLAY - silty, trace sand, moist, stiff, high plastic, brown	<input type="checkbox"/>	D1	16						■		
	CLAY (TILL) - silty, some sand, trace gravel, moist, very stiff, medium plastic, brown, coal and oxide specks, small silt and sand pockets	<input checked="" type="checkbox"/>	B2	25.3	●						▲	
	CLAY (TILL) - silty, some sand, trace gravel, moist, very stiff, medium plastic, brown, coal and oxide specks, small silt and sand pockets	<input type="checkbox"/>	D2	25						■		
2	End of Borehole @ 2.0 m											
	No Seepage, Minor Sloughing Upon Completion No Standpipe Installed											
3												10
4												15
5												16



LOGGED BY: SS	COMPLETION DEPTH: 2 m
REVIEWED BY: JZ	COMPLETE: 8/25/2015
DRAWING NO: B38	Page 1 of 1

PROJECT: VILLAGE OF GLENWOOD ROADWAYS	CLIENT: VILLAGE OF GLENWOOD	BOREHOLE NO: 15BH039
LOCATION: ALL INTERSECTIONS IN TOWN	DRILL METHOD: 150mm SOLID STEM AUGER	PROJECT: L12103982-01
CITY: GLENWOOD, AB	N - 5470932, E - 316909	

SAMPLE TYPE	<input checked="" type="checkbox"/> DISTURBED	<input type="checkbox"/> NO RECOVERY	<input checked="" type="checkbox"/> SPT	<input type="checkbox"/> A-CASING	<input type="checkbox"/> SHELBY TUBE	<input type="checkbox"/> CORE
BACKFILL TYPE	<input checked="" type="checkbox"/> BENTONITE	<input type="checkbox"/> PEA GRAVEL	<input type="checkbox"/> SLOUGH	<input type="checkbox"/> GROUT	<input type="checkbox"/> DRILL CUTTINGS	<input type="checkbox"/> SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	SPT (N)	MOISTURE CONTENT	PLASTICITY INDEX			STANDARD PENETRATION (N)	UNC. COMPRESSIVE STRENGTH (kPa)	POCKET PEN. (kPa)	Depth (ft)
						PLASTIC	M.C.	LIQUID				
0	ASPHALT (90 mm)											0
	GRAVEL (FILL) - sandy, silty, trace clay, subrounded, well graded, sizes to 50 mm, moist, loose											
	CLAY (FILL) - silty, some sand, some gravel, moist, stiff, medium plastic, grey with black staining, hydrocarbon odor, trace precipitates	<input checked="" type="checkbox"/>	B1	17.5	●				▲			
1		<input type="checkbox"/>	D1	11					■			
		<input checked="" type="checkbox"/>	B2	16	●				▲			
2		<input type="checkbox"/>	D2	12					■			
2	End of Borehole @ 2.0 m											
	No Seepage, Minor Sloughing Upon Completion No Standpipe Installed											
3												10
4												15
5												16



LOGGED BY: SS	COMPLETION DEPTH: 2 m
REVIEWED BY: JZ	COMPLETE: 8/20/2015
DRAWING NO: B39	Page 1 of 1

PROJECT: VILLAGE OF GLENWOOD ROADWAYS	CLIENT: VILLAGE OF GLENWOOD	BOREHOLE NO: 15BH040
LOCATION: ALL INTERSECTIONS IN TOWN	DRILL METHOD: 150mm SOLID STEM AUGER	PROJECT: L12103982-01
CITY: GLENWOOD, AB	N - 5470938, E - 316658	

SAMPLE TYPE	<input checked="" type="checkbox"/> DISTURBED	<input type="checkbox"/> NO RECOVERY	<input checked="" type="checkbox"/> SPT	<input type="checkbox"/> A-CASING	<input type="checkbox"/> SHELBY TUBE	<input type="checkbox"/> CORE
BACKFILL TYPE	<input checked="" type="checkbox"/> BENTONITE	<input type="checkbox"/> PEA GRAVEL	<input type="checkbox"/> SLOUGH	<input type="checkbox"/> GROUT	<input type="checkbox"/> DRILL CUTTINGS	<input type="checkbox"/> SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	SPT (N)	MOISTURE CONTENT	PLASTICITY INDEX			Depth (ft)
						PLASTIC	M.C.	LIQUID	
0	ASPHALT (50 mm) GRAVEL (FILL) - sandy, silty, trace clay, subrounded, well graded, sizes to 25 mm, moist, compact, dark brown CLAY (FILL) - silty, trace sand, trace gravel, moist, very stiff, high plastic, dark grey with black mottling, hydrocarbon odor	<input checked="" type="checkbox"/>	B1	20.2	20.2	40	50	60	0
1	CLAY (TILL) - silty, some sand, trace gravel, moist, stiff to very stiff, medium plastic, brown, coal and oxide specks, sand and silt pockets to 25 mm, trace precipitates  ... trace thin sand lenses	<input checked="" type="checkbox"/>	D1	14					5
2	End of Borehole @ 2.0 m  No Seepage, Minor Sloughing Upon Completion No Standpipe Installed	<input checked="" type="checkbox"/>	B2	20.3	20.3				10
3		<input checked="" type="checkbox"/>	D2	16					15
4									16

	LOGGED BY: SS	COMPLETION DEPTH: 2 m
	REVIEWED BY: JZ	COMPLETE: 8/20/2015
	DRAWING NO: B40	Page 1 of 1

PROJECT: VILLAGE OF GLENWOOD ROADWAYS	CLIENT: VILLAGE OF GLENWOOD	BOREHOLE NO: 15BH041
LOCATION: ALL INTERSECTIONS IN TOWN	DRILL METHOD: 150mm SOLID STEM AUGER	PROJECT: L12103982-01
CITY: GLENWOOD, AB	N - 5470728, E - 316889	

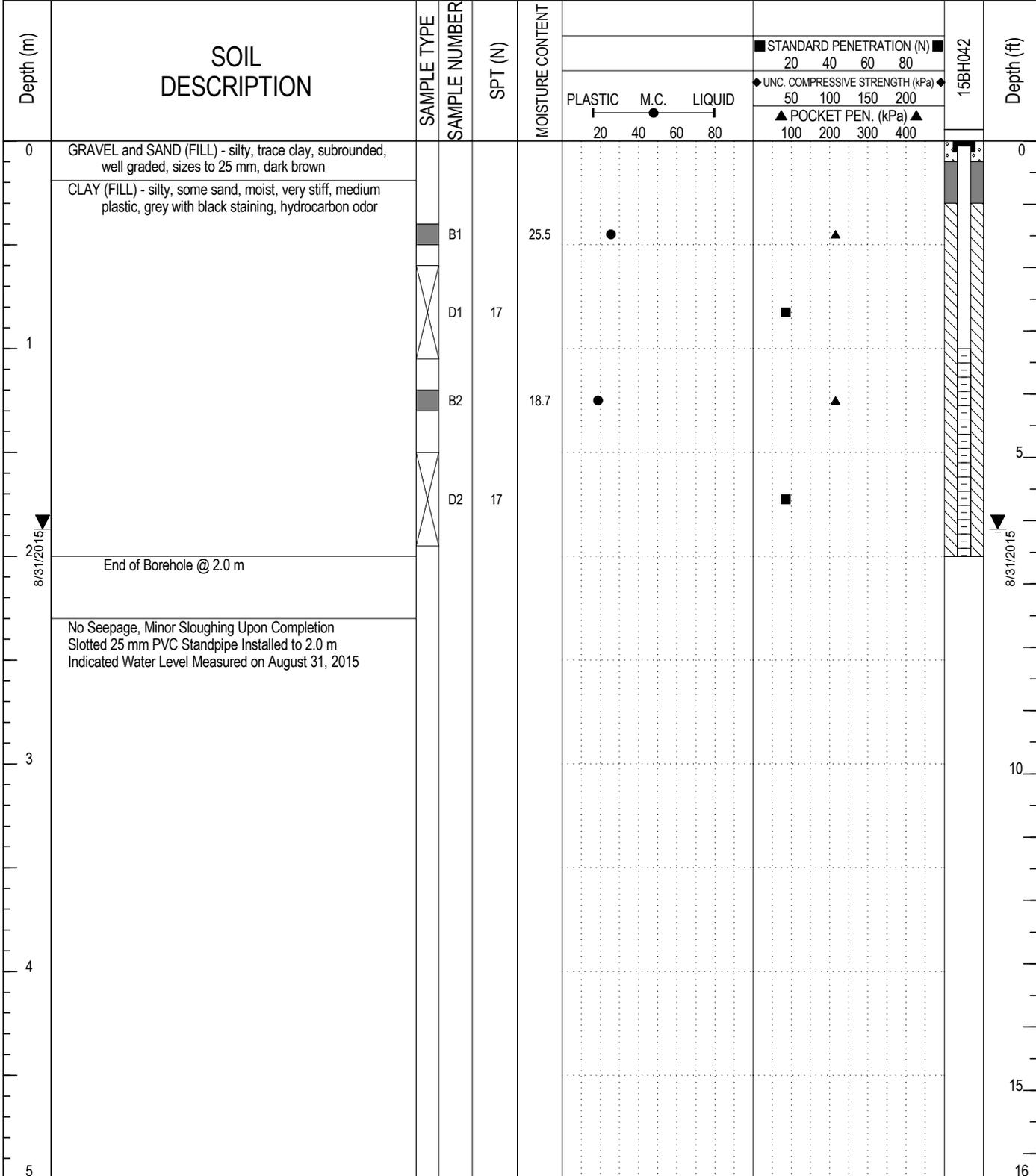
SAMPLE TYPE	<input checked="" type="checkbox"/> DISTURBED	<input type="checkbox"/> NO RECOVERY	<input checked="" type="checkbox"/> SPT	<input type="checkbox"/> A-CASING	<input type="checkbox"/> SHELBY TUBE	<input type="checkbox"/> CORE
BACKFILL TYPE	<input checked="" type="checkbox"/> BENTONITE	<input type="checkbox"/> PEA GRAVEL	<input type="checkbox"/> SLOUGH	<input type="checkbox"/> GROUT	<input type="checkbox"/> DRILL CUTTINGS	<input type="checkbox"/> SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	SPT (N)	MOISTURE CONTENT	PLASTICITY INDEX			Depth (ft)
						PLASTIC	M.C.	LIQUID	
0	ASPHALT (70 mm) CLAY (FILL) - silty, gravelly, silty, some sand moist, stiff, medium plastic, dark brown with grey mottling, hydrocarbon odor	<input checked="" type="checkbox"/>	B1	13	●				0
	... trace gravel, firm to stiff	<input type="checkbox"/>	D1	8					
	... coal and oxide specks, small sand and silt pockets, light grey with dark grey mottling	<input checked="" type="checkbox"/>	B2	17.9	●				
	CLAY (TILL) - silty, some sand, trace gravel, moist, stiff to very stiff, medium plastic, brown, coal and oxide specks, small sand and silt pockets	<input type="checkbox"/>	D2	16					
2	End of Borehole @ 2.0 m								
	No Seepage or Sloughing Upon Completion No Standpipe Installed								
3									10
4									15
5									16

 <b>TETRA TECH EBA</b>	LOGGED BY: SS	COMPLETION DEPTH: 2 m
	REVIEWED BY: JZ	COMPLETE: 8/20/2015
	DRAWING NO: B41	Page 1 of 1

PROJECT: VILLAGE OF GLENWOOD ROADWAYS	CLIENT: VILLAGE OF GLENWOOD	BOREHOLE NO: 15BH042
LOCATION: ALL INTERSECTIONS IN TOWN	DRILL METHOD: 150mm SOLID STEM AUGER	PROJECT: L12103982-01
CITY: GLENWOOD, AB	N - 5470527, E - 316883	

SAMPLE TYPE	<input checked="" type="checkbox"/> DISTURBED	<input type="checkbox"/> NO RECOVERY	<input checked="" type="checkbox"/> SPT	<input type="checkbox"/> A-CASING	<input type="checkbox"/> SHELBY TUBE	<input type="checkbox"/> CORE
BACKFILL TYPE	<input type="checkbox"/> BENTONITE	<input type="checkbox"/> PEA GRAVEL	<input type="checkbox"/> SLOUGH	<input type="checkbox"/> GROUT	<input type="checkbox"/> DRILL CUTTINGS	<input type="checkbox"/> SAND



	LOGGED BY: SS	COMPLETION DEPTH: 2 m
	REVIEWED BY: JZ	COMPLETE: 8/20/2015
	DRAWING NO: B42	Page 1 of 1



# APPENDIX C

## RECOMMENDED GENERAL DESIGN AND CONSTRUCTION GUIDELINES

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# CONSTRUCTION GUIDELINE

REVISION NO: 01 | LAST REVISED: AUGUST 10, 2015

## BACKFILL MATERIALS AND COMPACTION (GENERAL)

### 1.0 DEFINITIONS

“Landscape fill” is typically used in areas such as berms and grassed areas where settlement of the fill and noticeable surface subsidence can be tolerated. “Landscape fill” may comprise soils without regard to engineering quality.

“General engineered fill” is typically used in areas where a moderate potential for subgrade movement is tolerable, such as asphalt (i.e., flexible) pavement areas. “General engineered fill” should comprise clean, granular or clay soils.

“Select engineered fill” is typically used below slabs-on-grade or where high volumetric stability is desired, such as within the footprint of a building. “Select engineered fill” should comprise clean, well-graded granular soils or inorganic low to medium plastic clay soils.

“Structural engineered fill” is used for supporting structural loads in conjunction with shallow foundations. “Structural engineered fill” should comprise clean, well-graded granular soils.

“Lean-mix concrete” is typically used to protect a subgrade from weather effects including excessive drying or wetting. “Lean-mix concrete” can also be used to provide a stable working platform over weak subgrades. “Lean-mix concrete” should be low strength concrete having a minimum 28-day compressive strength of 3.5 MPa.

Standard Proctor Density (SPD) as used herein means Standard Proctor Maximum Dry Density (ASTM Test Method D698). Optimum moisture content is defined in ASTM Test Method D698.

### 2.0 GENERAL BACKFILL AND COMPACTION RECOMMENDATIONS

Exterior backfill adjacent to abutment walls, basement walls, grade beams, pile caps and above footings, and below highway, street, or parking lot pavement sections should comprise “general engineered fill” materials as defined above.

Exterior backfill adjacent to footings, foundation walls, grade beams and pile caps and within 600 mm of final grade should comprise inorganic, cohesive “general engineered fill”. Such backfill should provide a relatively impervious surficial zone to reduce seepage into the subsoil against the structure.

Backfill should not be placed against a foundation structure until the structure has sufficient strength to withstand the earth pressures resulting from placement and compaction. During compaction, careful observation of the foundation wall for deflection should be carried out continuously. Where deflections are apparent, the compactive effort should be reduced accordingly.

In order to reduce potential compaction induced stresses, only hand-held compaction equipment should be used in the compaction of fill within 1 m of retaining walls or basement walls. If compacted fill is to be placed on both sides of the wall, they should be filled together so that the level on either side is within 0.5 m of each other.

All lumps of materials should be broken down during placement. Backfill materials should not be placed in a frozen state, or placed on a frozen subgrade.

Where the maximum-sized particles in any backfill material exceed 50 percent of the minimum dimension of the cross-section to be backfilled (e.g., lift thickness), such particles should be removed and placed at other more suitable locations on site or screened off prior to delivery to site.

Bonding should be provided between backfill lifts. For fine-grained materials the previous lift should be scarified to the base of the desiccated layer, moisture-conditioned, and recompact and bonded thoroughly to the succeeding lift. For granular materials, the surface of the previous lift should be scarified to about a 75 mm depth followed by proper moisture-conditioning and recompaction.

### 3.0 COMPACTION AND MOISTURE CONDITIONING

“Landscape fill” material should be placed in compacted lifts not exceeding 300 mm and compacted to a density of not less than 90 percent of SPD unless a higher percentage is specified by the jurisdiction.

“General engineered fill” and “select engineered fill” materials should be placed in layers of 150 mm compacted thickness and should be compacted to not less than 98 percent of SPD. Note that the contract may specify higher compaction levels within 300 mm of the design elevation. Cohesive materials placed as “general engineered fill” or “select engineered fill” should be compacted at 0 to 2 percent above the optimum moisture content. Note that there are some silty soils which can become quite unstable when compacted above optimum moisture content. Granular materials placed as “general engineered fill” or “select engineered fill” should be compacted at slightly below (0 to 2%) the optimum moisture content.

“Structural engineered fill” material should be placed in compacted lifts not exceeding 150 mm in thickness and compacted to not less than 100 percent of SPD at slightly below (0 to 2%) the optimum moisture content.

### 4.0 “GENERAL ENGINEERED FILL”

Low to medium plastic clay is considered acceptable for use as “general engineered fill,” assuming this material is inorganic and free of deleterious materials.

Materials meeting the specifications for “select engineered fill” or “structural engineered fill” as described below would also be acceptable for use as “general engineered fill.”

### 5.0 “SELECT ENGINEERED FILL”

Low to medium plastic clay with the following range of plasticity properties is generally considered suitable for use as “select engineered fill”:

Liquid Limit	= 20 to 40%
Plastic Limit	= 10 to 20%
Plasticity Index	= 10 to 30%

Test results should be considered on a case-by-case basis.

“Pit-run gravel” and “fill sand” are generally considered acceptable for use as “select engineered fill.” See exact project or jurisdiction for specifications.

The “pit-run gravel” should be free of any form of coating and any gravel or sand containing clay, loam or other deleterious materials should be rejected. No material oversize of the specified maximum sieve size should be tolerated. This material would typically have a fines content of less than 10%.

The materials above are also suitable for use as “general engineered fill.”

## 6.0 “STRUCTURAL ENGINEERED FILL”

Crushed gravel used as “structural engineered fill” should be hard, clean, well graded, crushed aggregate, free of organics, coal, clay lumps, coatings of clay, silt, and other deleterious materials. The aggregates should conform to the requirement when tested in accordance with ASTM C136 and C117. See exact project or jurisdiction for specifications. This material would typically have a fines content of less than 10%.

In addition to the above, further specification criteria identified below should be met:

### “Structural Engineered Fill” – Additional Material Properties

Material Type	Percentage of Material Retained on 5 mm Sieve having Two or More Fractured Faces	Plasticity Index (<400 µm)	L.A. Abrasion Loss (percent Mass)
Various sized Crushed Gravels	See exact project or jurisdiction for specifications	See exact project or jurisdiction for specifications	See exact project or jurisdiction for specifications

Materials that meet the grading limits and material property criteria are also suitable for use as “select engineered fill.”

## 7.0 DRAINAGE MATERIALS

“Coarse gravel” for drainage or weeping tile bedding should be free draining. Clean, free-draining gravel or crushed rock generally containing no more than 5 percent fine-grained soil (particles passing No. 200 sieve) based on the fraction passing the 3/4-inch sieve. Or material with sand equivalent of at least 30.

“Coarse sand” for drainage should conform to the following grading limits:

### “Coarse Sand” Drainage Material – Percent Passing by Weight

Sieve Size	Coarse Sand*
10 mm	100
5 mm	95 – 100
2.5 mm	80 – 100
1.25 mm	50 – 90
630 µm	25 – 65
315 µm	10 – 35
160 µm	2 – 10
80 µm	0 – 3

\* From CSA A23.1-09, Table 10, “Grading Limits for Fine Aggregate”, Class FA1

Note that the “coarse sand” above is also suitable for use as pipe bedding material. See exact project or jurisdiction for specifications.

## 8.0 BEDDING MATERIALS

The “Coarse Sand” gradation presented above in Section 7.0 is suitable for use as pipe bedding and as backfill within the pipe embedment zone, however see exact project or jurisdiction for specifications.